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TNT EQUIVALENCY OF BALL POWDER WC844

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US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
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This project was accomplished as part of the U.S. Army's Manufacturing Methods and Technology Program. The primary objective of this program is to develop, on a timely basis, manufacturing processes, techniques, and equipment for use in the production of Army materiel.

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MMT-ammunition
TNT equivalency
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L/D ratio
Shipping containers
Dryer beds

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Peak side-on blast overpressure and scaled positive impulse have been measured for ball powder WC844 using configurations that simulate in-plant processing and shipping containers. Quantities of 22.7, 36.3, 45.4, and 72.6 kg were tested in cylindrical shipping containers and in simulated sections of dryer beds. High explosive equivalency values for each test series were obtained as a function of scaled distance by comparison to known pressure and impulse characteristics for TNT surface bursts. Equivalencies were found to depend significantly on geometry.

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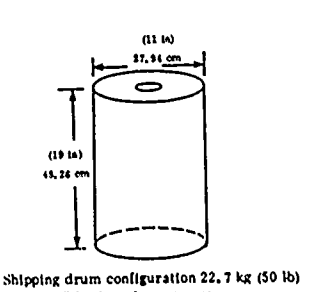
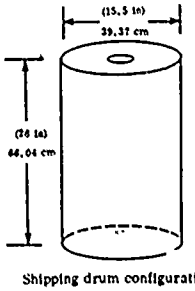
SUMMARY

Ball powder WC844 (double base propellant) was detonated in configurations representative of shipping containers and simulated in-plant process dryer beds. Blast output parameters were measured and TNT equivalency was computed based on comparison with TNT hemispherical surface bursts. The results of these tests are shown below. To within experimented error, the pressure and impulse of ball powder WC844 with an L/D ratio greater than 1:1 in charge weights of 22.7 kg (50 lb) and 45.4 kg (100 lb) scaled with the cube root of the charge weight. TNT equivalency values for pressure and impulse were generally greater than 100% at all scaled distances. Charge weights of 36.3 kg (80 lb) and 72.6 kg (160 lb), representing the dryer bed configuration scaled as a cube root function of the charge weight. A notable difference existed in pressure and impulse values due to the geometry of the dryer bed. Odd gage values for both pressure and impulse values were generally less than 100% at the near field values < 7.14 m/kg$^{1/3}$ and greater than 100% at the far field values ≥ 7.14 m/kg$^{1/3}$. The even gage line values were found to be generally greater than 100% at all scaled distances with the exception of those values measured at a scaled distance = 2.14 m/kg$^{1/3}$. TNT equivalency values for the dryer bed configuration were generally less than the values found in the shipping container except at the far field values ≥ 7.14 m/kg$^{1/3}$, where pressure and impulse values for the dryer bed configuration were greater than those in the shipping container configuration.

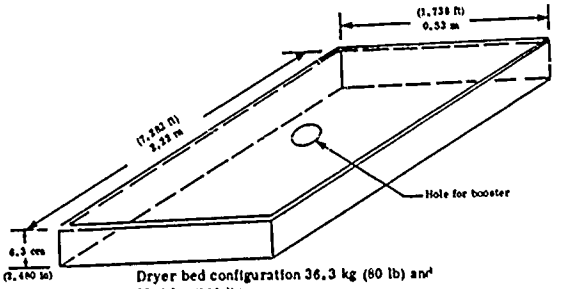
Configuration Mass		Pressure (P) and Impulse (I) TNT Equivalency (%) at Scaled Distance											
		1.19 m/kg$^{1/3}$ (3.0 ft/lb$^{1/3}$)		1.59 m/kg$^{1/3}$ (4.0 ft/lb$^{1/3}$)		2.14 m/kg$^{1/3}$ (5.4 ft/lb$^{1/3}$)		3.57 m/kg$^{1/3}$ (9.0 ft/lb$^{1/3}$)		7.14 m/kg$^{1/3}$ (18.0 ft/lb$^{1/3}$)		15.9 m/kg$^{1/3}$ (40 ft/lb$^{1/3}$)	
		P	I	P	I	P	I	P	I	P	I	P	I
Shipping container 22.7 kg 45.4 kg		390	230	325	150	190	120	160	110	160	105	170	95
Dryer bed 36.3 kg 72.6 kg	Odd	80	35	55	25	40	75	75	95	170	135	360	140
	Even	135	105	135	105	85	80	130	70	150	110	200	135



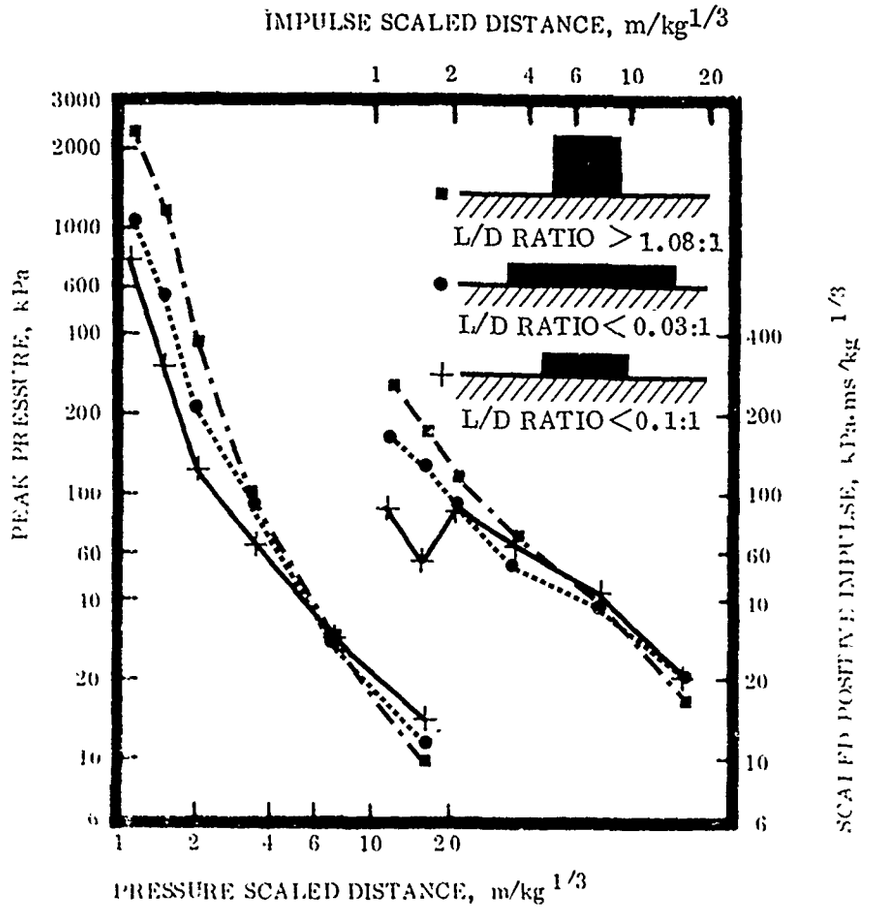
Shipping drum configuration 22.7 kg (50 lb)
Fiberboard construction

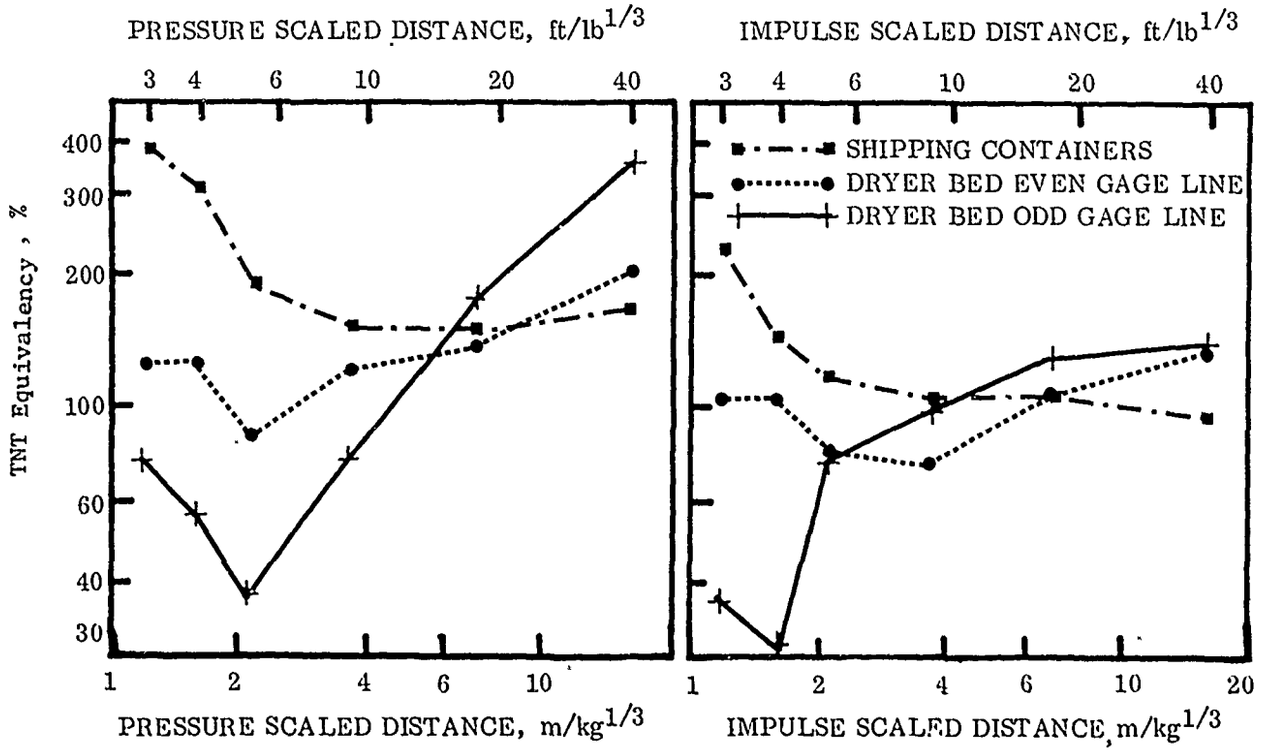


Shipping drum configuration
45.4 kg (100 lb)
Fiberboard construction



Dryer bed configuration 36.3 kg (80 lb) and
72.6 kg (160 lb)
Plywood construction


IMPULSE SCALED DISTANCE, m/kg1/3
1 2 4 6 10 20
3000
2000
1000
600
100
200
100
60
10
20
10
6
PEAK PRESSURE, kPa
L/D RATIO > 1.08:1
L/D RATIO < 0.03:1
L/D RATIO < 0.1:1
400
200
100
60
10
20
10
6
SCALED POSITIVE IMPULSE, kPa-ms/kg 1/3
1 2 4 6 10 20
PRESSURE SCALED DISTANCE, m/kg 1/3


PRESSURE SCALED DISTANCE, ft/lb1/3
IMPULSE SCALED DISTANCE, ft/lb1/3
3 4 6 10 20 40
400
300
200
100
60
40
30
TNT Equivalency, %
SHIPPING CONTAINERS
DRYER BED EVEN GAGE LINE
DRYER BED ODD GAGE LINE
1 2 4 6 10
1 2 4 6 10 20
PRESSURE SCALED DISTANCE, m/kg1/3
IMPULSE SCALED DISTANCE, m/kg1/3

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INTRODUCTION

Background

A pilot plant for manufacturing double base propellant in the form of ball powder has been set up at a GOCO plant. The information generated from the pilot plant operation will be used to size the various equipment, material balance, and structural and safe operating procedures for modernization Project 5842879 and expansion project 5843128. Material produced will be ball powder WC844, WC846, and WC870. The basic composition is approximately 86% nitrocellulose (NC), 8.2% nitroglycerin (NG), and 5% dibutylphthalate.

The powder, as it is pumped through the process in a 3:1 (water/powder) slurry, is shaped into spheroidal balls, passed over screens for size classification, pumped in a slurry form to a centrifuge where the powder at 8 to 9% moisture is fed onto dryer beds for drying, and then moved to packout for storage. The finished material is a ball powder, sized from 0.41 to 0.66 mm (0.016 to 0.026 in.) for NATO rounds. The powder is stored and shipped in 22.7 and 45.4 kg (50 and 100 lb) quantities in fiber drums.

Safety engineering and cost effectiveness considerations require knowledge of hazardous material characteristics as an input to facility design requirements. In this instance, specific data are required on the explosive output characteristics of ball powder WC844 in quantities and configurations representative of those found in processing, storage, and shipping facilities.

Objectives

One objective was to determine the maximum output from ball powder WC844 in terms of the airblast overpressure and positive impulse and to determine if the quantities tested scale as a function of the cube root of the charge weight.

Another objective was to compare the measured pressure and impulse with known TNT test data to determine the equivalency of ball powder WC844 in relation to TNT.

EXPERIMENTAL METHODS

Materials

The test material was a double base propellant, ball powder WC844, for the 5.56 round, DAAA-25-70-C-0613, Army lot 46705, Small Lot 50 manufacture date C-5-71 by Olin Corporation, St. Marks, Florida. It was received in 45.4 kg (100 lb) quantities in cylindrical cardboard shipping containers.

Test Plan

Airblast output was evaluated for masses and configuration of ball powder WC844, representative of standard shipping containers at two charge weights and dryer beds at two charge weights. A cylindrical fiberboard container was used as the 22.7 kg (50 lb) shipping container (A, fig. 1), and as the 45.4 kg (100 lb) shipping container (B, fig. 1). An orthorombic fixture was used for 36.3 kg (80 lb) and 72.6 kg (160 lb) dryer bed simulation (C, fig. 1). The fixture was constructed from 0.953 cm (3/8 in.) plywood with dimensions of 2.22 m long by 0.53 m wide by 6.3 cm deep (7.83 ft x 1.738 ft x 2.480 in.). The long side of the box was perpendicular with the even gage line.

A composition C4 conically shaped booster charge with a length-to-diameter ratio of 1:2 (L/D) was centered on top of each test charge. The weight of the booster charge was held constant at 0.454 kg (1 lb) for all tests. The booster was initiated with an engineers' special J2 blasting cap inserted in the apex and embedded to the center of the core.

The test charges in each configuration were placed on a 1010 carbon steel witness plate, 1.27 cm (0.5 in.) thick with dimensions of at least 5.08 cm (2 in.) greater than the size of the test container.

Instrumentation

Twelve side-on pressure transducers were mounted flush to the surface in each of two sand filled 90° arrays, within the test area as shown in figure 2. Distances from the charge to the transducer corresponded to scaled distances from 1.19 to 15.87 $m/kg^{1/3}$ (3 to

40 ft/lb$^{1/3}$. Scaled distances were held constant throughout the test series for all charge weights and configurations. The transducers were individually calibrated prior to the beginning of each test series with pressure pulses from a standard solenoid actuated air pressure calibration fixture, adjusted to correspond to expected blast pressure based on an assumed TNT equivalency of 100%. Signal line continuity and channelization were checked prior to each test, and electrical calibration of the recording system was checked daily. Details of distances between charge and transducers, calibration pressure, and expected peak blast pressure at each distance are shown in table 1.

Photographic coverage was restricted to one test of each configuration (fig. 3). Motion picture coverage included a Mitchell camera Model H516-E4 operating at 500 frames per second (fps) and one Mitchell camera (same model) operating at 24 fps. Before and after color photographs were taken for each test, showing typical setup and results. Standard meteorological data were recorded for each test.

RESULTS

Data Analysis

Peak blast overpressure and positive impulse information were obtained in digital form. Inconsistent results that could be attributed to instrumentation or test material malfunction were deleted from consideration at calculation. Additionally, the raw test data were averaged and the standard deviation was calculated; all data that fell outside the one standard deviation from the mean were also deleted from the TNT equivalency calculations. The data were then compared to data from the standard TNT hemispherical (fig. 4). McKown (ref 1) describes the computer program which uses an iterative process that factors out the contribution of the booster charge weight and calculates the pressure and impulse equivalencies. With the effect of the booster weight factored out, the calculated TNT equivalencies were tabulated and plotted as functions of sample scaled distances.

Test Results

Data sheets for all tests with pertinent measured parameters are given in the appendix.

Mean pressure, scaled positive impulse, and time of arrival data are summarized by test configuration in tables 2 through 8 and figures 5 through 10. Composite pressure and scaled impulse values for the shipping containers are given in table 10 and 11. The dryer bed combined charge weights are given as results for odd gage and even gage results in tables 8 and 9 and figure 12. Fireball diameter and duration as measured from high speed motion pictures are given in table 11.

Figures 13 through 20 show typical pretest and posttest configurations for the charge weights tested.

Discussion

The plots of peak pressure and scaled positive impulse versus scaled distance for the shipping container configuration are shown in figures 5 and 6. They show that the pressure values are generally greater than 100% at all scaled distances when compared to the same charge weight of TNT at the same scaled distances. Scaled positive impulse for the 22.7 kg (50 lb) charge weight is generally greater than 100% at all scaled distances $\leq$ 7.14 m/kg$^{1/3}$ (18 ft/lb$^{1/3}$) and less than 100% at 15.9 m/kg$^{1/3}$ (40 ft/lb$^{1/3}$) when compared to equal amounts of TNT. The same general trend was noted for the 45.4 kg (100 lb) shipping container except that at a scaled distance of 3.57 m/kg$^{1/3}$ (9 ft/lb$^{1/3}$) the scaled positive impulse value was slightly less than 100%. However, when the results of the 22.7 kg and 45.4 kg (50 and 100 lb) shipping container were combined (fig. 11), scaled positive impulse was found to be greater than 100% at scaled distances $\leq$ 7.14 m/kg$^{1/3}$ (18 ft/lb$^{1/3}$) and less than 100% at scaled distances $>$ than 7.14 m/kg$^{1/3}$ (18 ft/lb$^{1/3}$).

Results obtained in the dryer bed configuration showed a significant difference from those values obtained in the shipping container configuration and show the effect of geometry. Test results for the 36.3 kg (80 lb) test are given in table 4 and figure 7 for the odd gage line and table 5 and figure 8 for the even gage line. Equivalency pressure for the odd gage line (short side of dryer bed) was generally less than 100 percent at the near field scaled distance $<$ 3.57 m/kg$^{1/3}$ (9 ft/lb$^{1/3}$). Scaled positive impulse followed the same general trend as the pressure, but there was a significant dip in impulse value at a scaled distance of 1.59 m/kg$^{1/3}$ (4 ft/lb$^{1/3}$).

Peak pressure for the even gage line (long side of dryer bed) for the 36.3 kg (80 lb) mass showed significantly different results. Generally, pressure values were greater than 100% at all

scaled distances with the exception found at 2.14 $m/kg^{1/3}$ (5.4 $ft/lb^{1/3}$) where it was less than 100%. Scaled positive impulse values were found to be less than 100% at the near field values < 7.14 $m/kg^{1/3}$ (18$ft/lb^{1/3}$) and greater than 100% at scaled distances $\geq$ 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$). In this instance there was no pronounced dip in the impulse values at the close-in scaled distance of 1.59 $m/kg^{1/3}$ (4 $ft/lb^{1/3}$) as was detected from the short side of the dryer bed gage line.

Peak pressure and scaled positive impulse values obtained on the dryer bed configuration for the 72.6 kg (160 lb) charge weight followed the same general pattern found for even and odd gage measurement. On the short side or end of the dryer bed, a noticeable dip in impulse value exists and was somewhat more pronounced for the larger mass. The even gage line scaled positive impulse values were greater than 100% at 1.19 and 1.59 $m/kg^{1/3}$ (3 and 4 $ft/lb^{1/3}$), less than 100% at 2.14 and 3.57 $m/kg^{1/3}$ (5.4 and 9 $ft/lb^{1/3}$), and greater than 100% at far field scaled distance $\geq$ 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$).

The significance of the 36.3 and 72.6 kg charge tests in the dryer bed configuration was in the results of the odd gage line and the dip in the impulse value of 1.59 $m/kg^{1/3}$ (4$ft/lb^{1/3}$). This dip is similar to those values reported by Kingery (ref 2) in the development of impulse curve for 500 and 1000 ton TNT equivalency tests. However, these values occurred at near field value of 0.79 $m/kg^{1/3}$ (2 $ft/lb^{1/3}$). Another difference is noted in the L/D ratio from the long side of the dryer bed versus the short side. The L/D ratio for the short side was 0.06:1 for the 36.3 kg (80 lb) tests and 0.12:1 for 72.6 kg (160 lb) tests whereas the L/D ratios were 0.01 and 0.03 on the long side of the dryer bed configuration for the 36.3 and 72.6 kg (80 and 160 lb) tests respectively, with the difference being the height of the material.

To within experimental error of the instrumentation and variance in explosive material, scaling as a function of the cube root of the charge weight occurred, pressure and impulse values did not necessarily increase or decrease as a function of the charge weight. There were some slight variances in values, but no significant increase or decrease was evident.

CONCLUSIONS

1. Peak positive overpressure TNT equivalency values of ball powder WC844 in two types of shipping containers were found to be greater than 100% at all scaled distances tested when compared to the standard TNT hemispherical reference.

2. Scaled positive impulse TNT equivalency values for the shipping containers were greater than 100% at the near field vaues $\leq$ 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$) and less than 100% at scaled distances greater than 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$).

3. TNT equivalency values of ball powder WC844 in the dryer bed configuration were dependent upon geometry since there were significant differences in results between the long and short sides of the dryer bed.

4. Pressure equivalency in the dryer bed configuration was generally greater than 100% at all scaled distances on the long side of the dryer bed. Impulse values were greater than 100% at close-in scaled distances, below 100% at the mid-range scaled distances, and greater than 100% at the far field scaled distance.

5. Pressure and impulse equivalency for the short side (odd gage) was generally less than 100% at scaled distance < 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$) and greater than 100% at scaled distance $\geq$ 7.14 $m/kg^{1/3}$ (18 $ft/lb^{1/3}$).

6. Within experimental limits of the instrumentation and explosive material, blast pressure and scaled positive impulse scaled as a cube root function of charge weight when geometries were similar.

RECOMMENDATION

The TNT equivalency of pressure and impulse values determined from this test series should be used in the structural design of protective facilities.

REFERENCES

1. G. L. McKown, "TNT Equivalency of R284 Tracer Composition, I559 Igniter Mix, and I560 Subigniter Mix," ARRADCOM Technical Report ARLCD-TR-79026, ARRADCOM, Dover, NJ, August 1979.

2. C. N. Kingery, "Air Blast Parameters Versus Distance for Hemispherical TNT Surface Bursts," BRL Report 1344, Ballistic Research Laboratory, Aberdeen, MD, September 1966.

Table 1. Transducer calibration and placement

distances between charge and transducers, calibration pressure and expected peak blast pressure at each distance are shown in table 1.

Photographic coverage was restricted to one test of each configuration (figure 3). Motion picture coverage included a Mitchell camera Model H516-E4 operating at 500 frames per second (fps) and one Mitchell camera (same model) operating at 24 fps. Before and after color still photographs were taken of each test showing typical setup and results. Standard meteorological data were recorded for each test.

TABLE 1. TRANSDUCER CALIBRATION AND PLACEMENT

Channel number	Scaled distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Full-scale calibration pressure kPa (psig)	Expected pressure kPa (psi)	R_1 distance in meters (ft) from charge			
				Charge weight 22.68 kg (50)	Charge weight 36.3 kg (80)	Charge weight 45.4 kg (100)	Charge weight 72.6 kg (160)
1, 2	1.19 (3.0)	1379 (200)	917 (133)	3.37 (11.05)	3.94 (12.93)	4.24 (13.92)	4.97 (16.29)
3, 4	1.59 (4.0)	689.5 (100)	479.7 (69.58)	4.49 (14.74)	5.32 (17.45)	5.73 (18.8)	6.7 (21.99)
5, 6	2.14 (5.4)	413.1 (60)	242.5 (35.17)	6.06 (19.89)	7.06 (23.18)	7.61 (24.97)	8.9 (29.2)
7, 8	3.57 (9.0)	206.8 (30)	87.9 (12.74)	10.11 (33.2)	11.82 (38.78)	12.73 (41.77)	14.89 (48.86)
9, 10	7.14 (18.0)	68.9 (10)	24.9 (3.6)	20.21 (66.3)	23.64 (77.56)	25.47 (83.55)	19.78 (97.72)
11, 12	15.87 (40.0)	34.5 (5)	7.58 (1.1)	44.9 (147.4)	52.53 (172.35)	56.59 (185.66)	66.19 (217.15)

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Table 2. Summary of test results, 22.7 kg (50 lb) cylindrical charge

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
3.37 (11.05)	1.19 (3.0)	3.25	2471.7 (358.49)	309.87 (34.53)	388	231
4.49 (14.74)	1.59 (4.0)	4.45	1123.22 (162.91)	177.95 (19.83)	316	156
6.06 (19.89)	2.14 (5.4)	6.13	390.8 (56.68)	121.6 (13.55)	185	125
10.11 (33.2)	3.57 (9.0)	14.65	112 38 (16.3)	83.73 (9.33)	166	135
20.21 (66.3)	7.14 (18.0)	40.5	31.85 (4.62)	40.38 (4.5)	167	112
44.92 (147.4)	15.87 (40.0)	111.35	10.69 (1.55)	16.33 (1.82)	183	90

Table 3. Summary of test results, 45.4 kg (100 lb) cylindrical charge

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
4.24 (13.92)	1.19 (3.0)	3.6	2477.42 (359.32)	284.38 (31.74)	390	231
5.73 (18.8)	1.59 (4.0)	4.36	1091.65 (158.33)	155.25 (17.3)	282	149
7.61 (24.97)	2.14 (5.4)	7.18	413 (59.9)	116.66 (13)	199	117
12.73 (41.77)	3.57 (9.0)	16.94	102.66 (14.89)	66.7 (7.42)	150	93
25.47 (83.55)	7.14 (18.0)	50.5	29.16 (4.23)	37.06 (4.13)	141	100
56.59 (185.66)	15.87 (40.0)	137.63	10.2 (1.48)	17.14 (1.91)	164	98

Table 4. Summary of test results, 36.3 kg (80 lb) charge, odd gage configuration

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ $(ft/lb^{1/3})$	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	Pressure TNT Equivalency %	Impulse TNT Equivalency %
3.94 (12.93)	1.19 (3.0)	3.1	734 (106.45)	105 (11.68)	73	44
5.32 (17.45)	1.587 (4.0)	5.23	314 (45.57)	60.4 (6.73)	57	26
7.07 (23.18)	2.14 (5.4)	9.07	115 (16.62)	86.2 (9.6)	33	70
11.82 (38.78)	3.57 (9.0)	21.27	63.1 (9.15)	68.02 (7.58)	67	96
23.64 (77.56)	7.14 (18.0)	53	29.4 (4.26)	44 (4.9)	145	128
52.53 (172.35)	15.87 (40.0)	133.43	15.4 (2.24)	24.14 (2.69)	420	165

Table 5. Summary of test results, 36.3 kg (80 lb) charge, even gage configuration

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ $(ft/lb^{1/3})$	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	Pressure TNT Equivalency %	Impulse TNT Equivalency %
3.94 (12.93)	1.19 (3.0)	3.97	926 (134.28)	169 (18.78)	101	96
5.32 (17.45)	1.587 (4.0)	5.78	479 (69.45)	125 (13.93)	102	89
7.07 (23.18)	2.14 (5.4)	8.8	210 (30.41)	90.3 (10.06)	77	76
11.82 (38.78)	3.57 (9.0)	19.2	98.3 (14.25)	56.9 (6.34)	141	72
23.64 (77.56)	7.14 (18.0)	49.57	29.9 (4.34)	38.7 (4.31)	150	104
52.53 (172.35)	15.87 (40.0)	130.33	11.16 (1.62)	20.6 (2.3)	200	129

Table 6. Summary of test results, 72.6 kg (160 lb) charge, odd gage configuration

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
4.97 (16.29)	1.19 (3.0)	4.23	935 (135.67)	92.5 (10.31)	105	36
6.7 (21.99)	1.587 (4.0)	6.93	286 (41.42)	61.2 (6.82)	50	27
8.9 (29.21)	2.14 (5.4)	11.7	138 (19.98)	98 (10.92)	43	89
14.89 (48.86)	3.57 (9.0)	27.32	75.2 (10.91)	55.7 (6.21)	89	73
29.79 (97.72	7.14 (18.0)	66.53	40.4 (5.86)	45.9 (5.12)	256	138
66.19 (217.15)	15.87 (40.0)	167.07	12.76 (1.85)	20.3 (2.26)	272	126

Table 7. Summary of test results, 72.6 kg (160 lb) charge, even gage configuration

Radius meters (ft)	Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
4.97 (16.29)	1.19 (3.0)	4.93	1398 (202.82)	195 (21.73)	180	123
6.7 (21.99)	1.587 (4.0)	6.83	606 (87.71)	135 (14.99)	141	100
8.9 (29.21)	2.14 (5.4)	10.23	- (40.83)	92.7 (10.33)	117	80
14.89 (48.86)	3.57 (9.0)	23.6	84.7 (12.28)	54.1 (6.03)	110	67
29.79 (97.72)	7.14 (18.0)	62.3	30 (4.35)	45.8 (5.1)	151	139
66.19 (217.15)	15.87 (40.0)	165.2	11.24 (1.63)	21 (2.34)	204	133

Table 8 Summary of test results, composite odd gage dryer bed configuration

Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
1.19 (3.0)	0.78	757 (109.85)	92.8 (10.34)	77	36
1.587 (4.0)	1.25	307 (44.51)	58.3 (6.5)	55	25
2.14 (5.4)	2.09	125 (18.14)	90.5 (10.08)	37	76
3.57 (9.0)	4.98	68 (9.86)	68 (7.58)	76	96
7.14 (18.0)	12.34	29.9 (4.34)	45.2 (5.04)	170	134
15.87 (40.0)	31.05	14.3 (2.08)	21.6 (2.41)	361	139

Table 9. Summary of test results, composite even gage dryer bed configuration

Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
1.19 (3.0)	0.93	1136 (164.73)	178 (19.78)	135	105
1.587 (4.0)	1.26	587 (85.08)	137 (15.24)	135	108
2.14 (5.4)	1.9	225 (32.6)	92 (10.23)	86	78
3.57 (9.0)	4.34	93.5 (13.56)	56.3 (6.27)	130	72
7.14 (18.0)	11.58	29.7 (4.31)	39.2 (4.37)	148	107
15.87 (40.0)	30.34	11.1 (1.61)	21 (2.35)	200	133

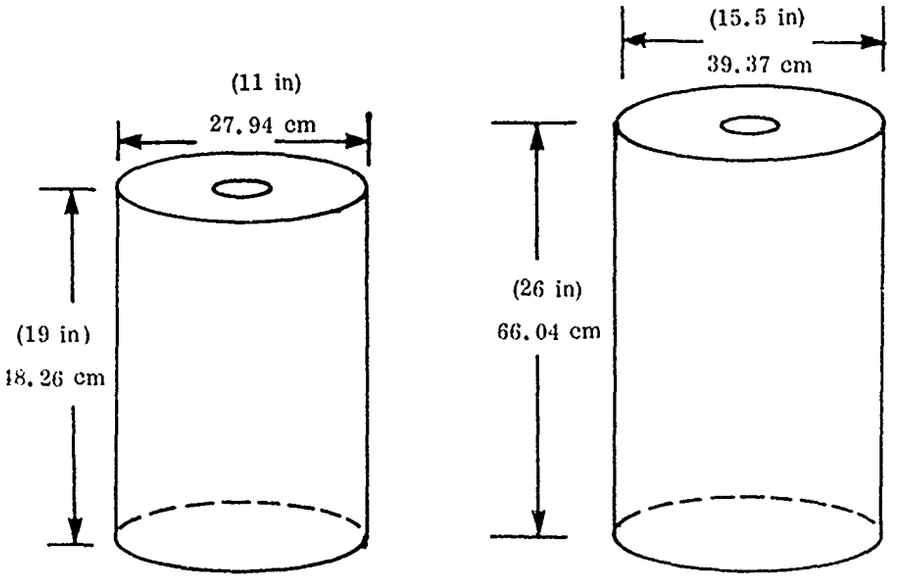
Table 10. Summary of test results, composite results with L/D ratio greater than 1:1

Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Time of Arrival (msec)	Peak Pressure kPa (psi)	Scaled Positive Impulse $kPa \cdot ms/kg^{1/3}$ ($psi \cdot ms/lb^{1/3}$)	Pressure TNT Equivalency %	Impulse TNT Equivalency %
1.19 (3.0)	0.75	2498 (362.33)	285 (31.78)	388	231
1.59 (4.0)	1.03	1161 (168.35)	175 (19.49)	326	149
2.14 (5.4)	1.55	398 (57.78)	120 (13.39)	190	122
3.57 (9.0)	3.8	108.4 (15.72)	72.9 (8.12)	157	108
7.14 (18.0)	10.92	31.2 (4.52)	39.3 (4.38)	157	107
15.87 (40.0)	29.92	10.3 (1.49)	16.9 (1.88)	168	94

Table 11. Fireball duration and diameter

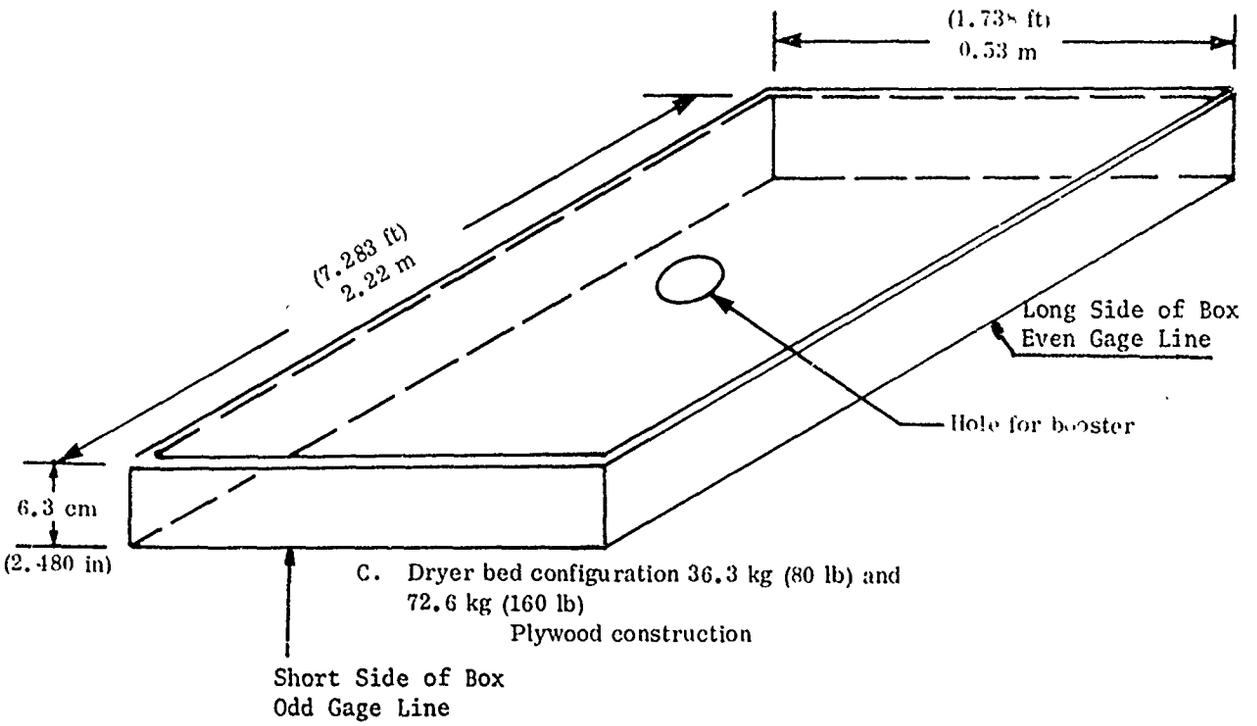
TABLE 11. FIREBALL DURATION AND DIAMETER

Charge Weight kg (lb)	Maximum Fireball Diameter meters (ft)	Fireball Duration msec
22.7 (50)	13.72 (45)	112
45.4 (100)	21.34 (70)	148
36.3 (80)	13.72 (45)	192
72.6 (160)	16.76 (55)	375



A. Shipping drum configuration 22.7 kg (50 lb) Fiberboard construction

B. Shipping drum configuration 45.4 kg (100 lb) Fiberboard construction



C. Dryer bed configuration 36.3 kg (80 lb) and 72.6 kg (160 lb)
Plywood construction

Figure 1. Test Container Configurations

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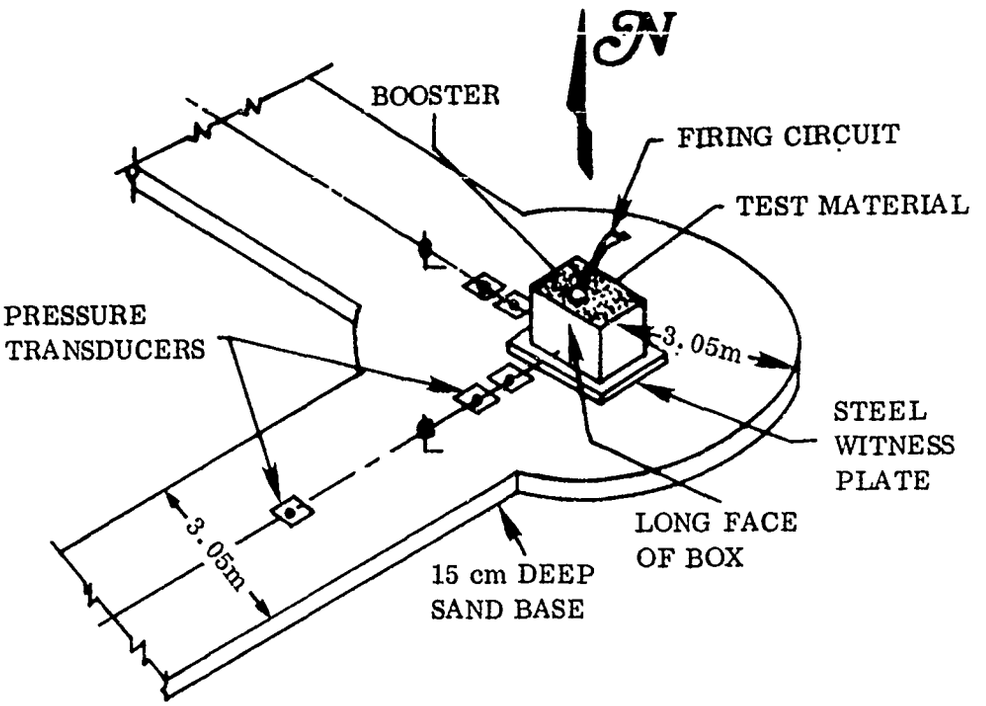

Figure 2. Typical Charge Placement for Equivalency Tests

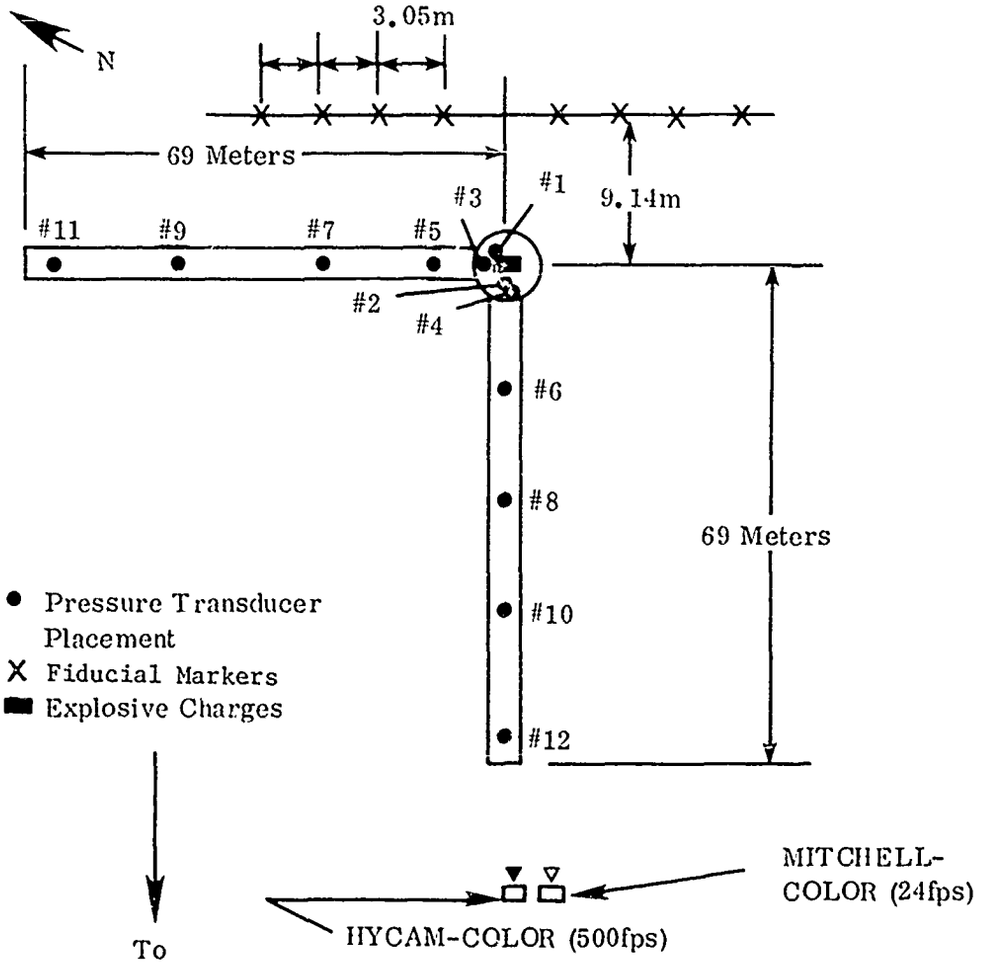

Figure 3. Test Area Showing Transducer and Camera Placement

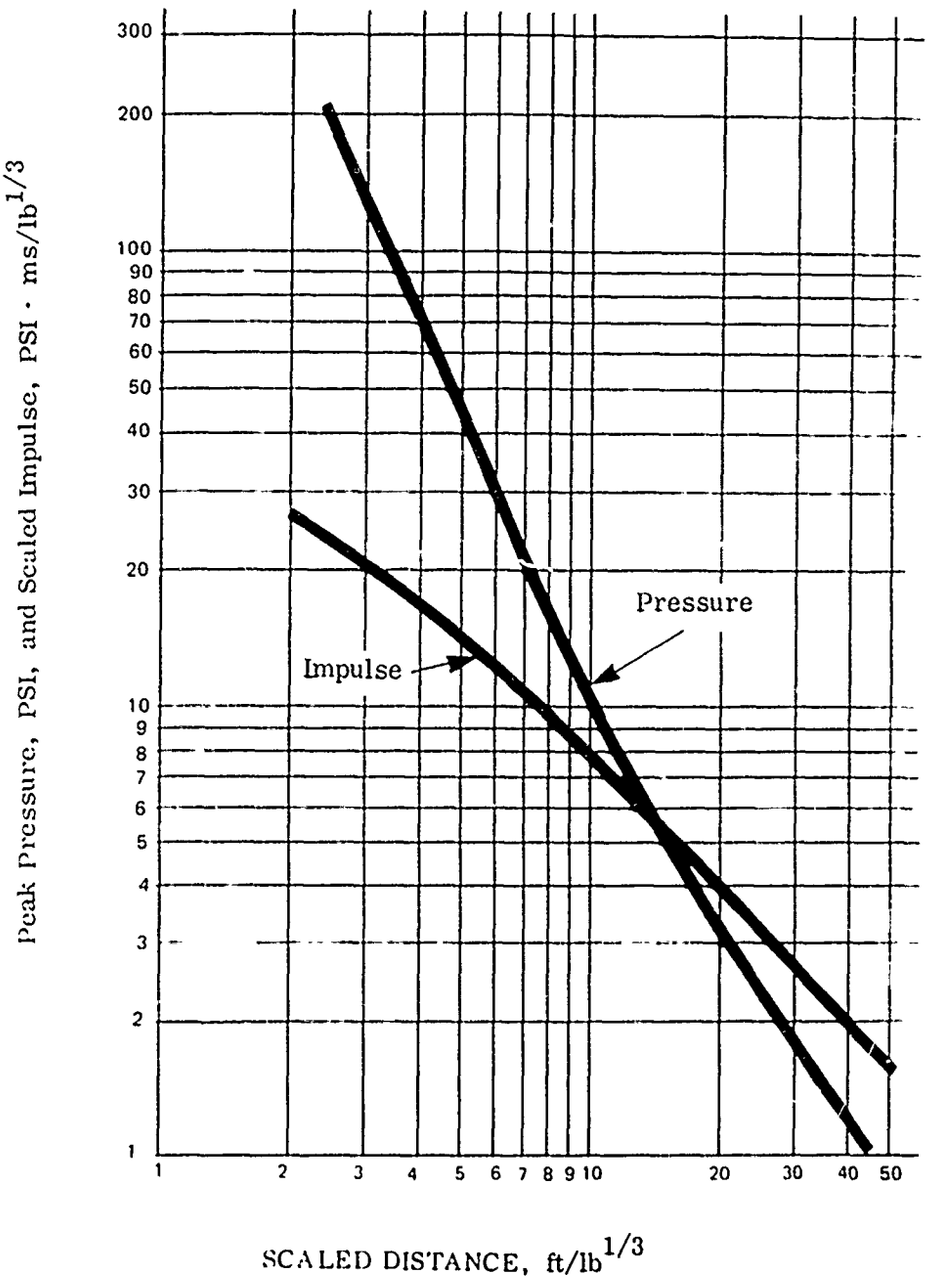

Figure 4. TNT Hemispherical Surface Burst

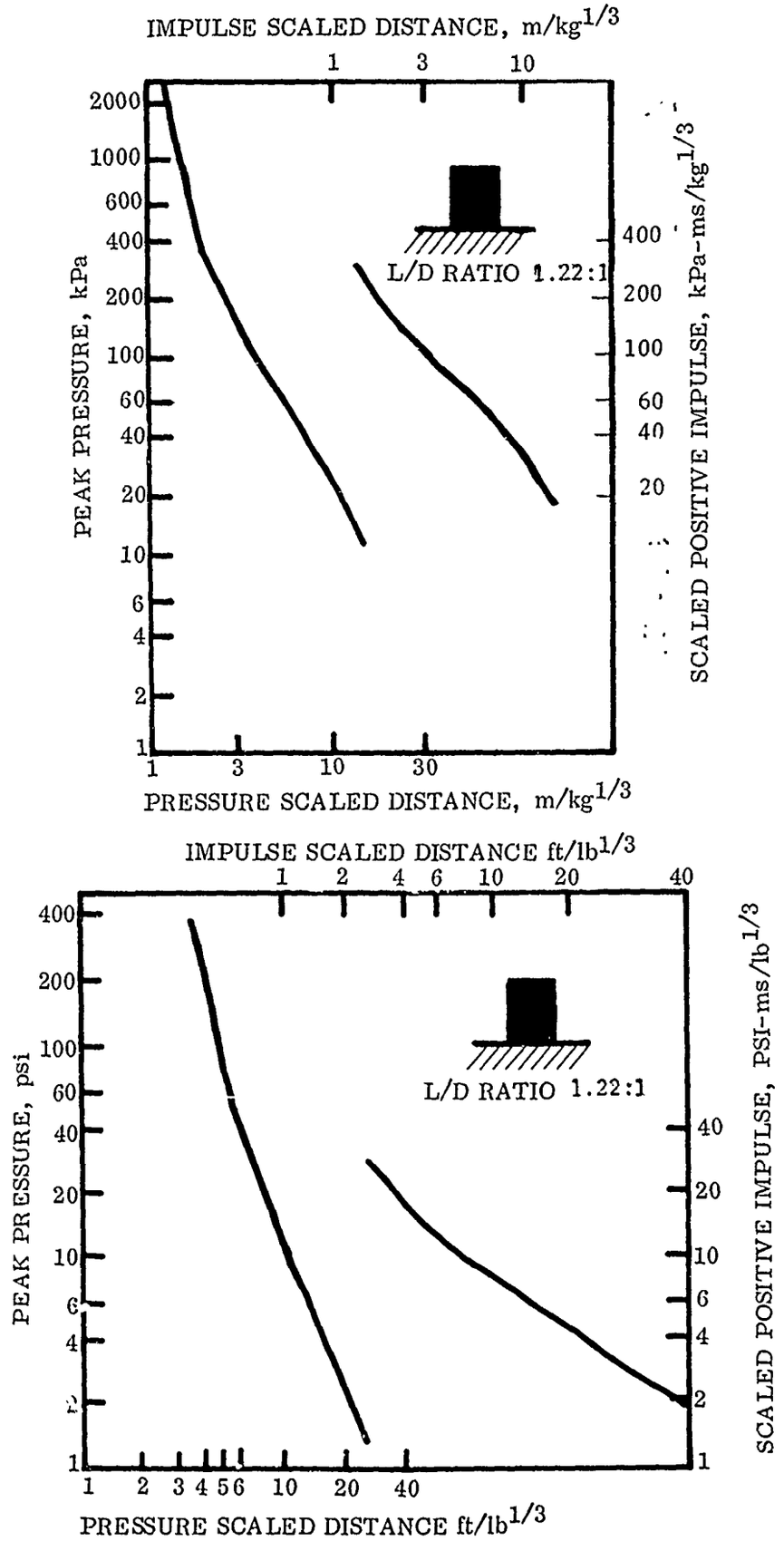

Figure 5. Pressure and Impulse versus Scaled Distance 22.7 kg (50 lb) Charge Weights

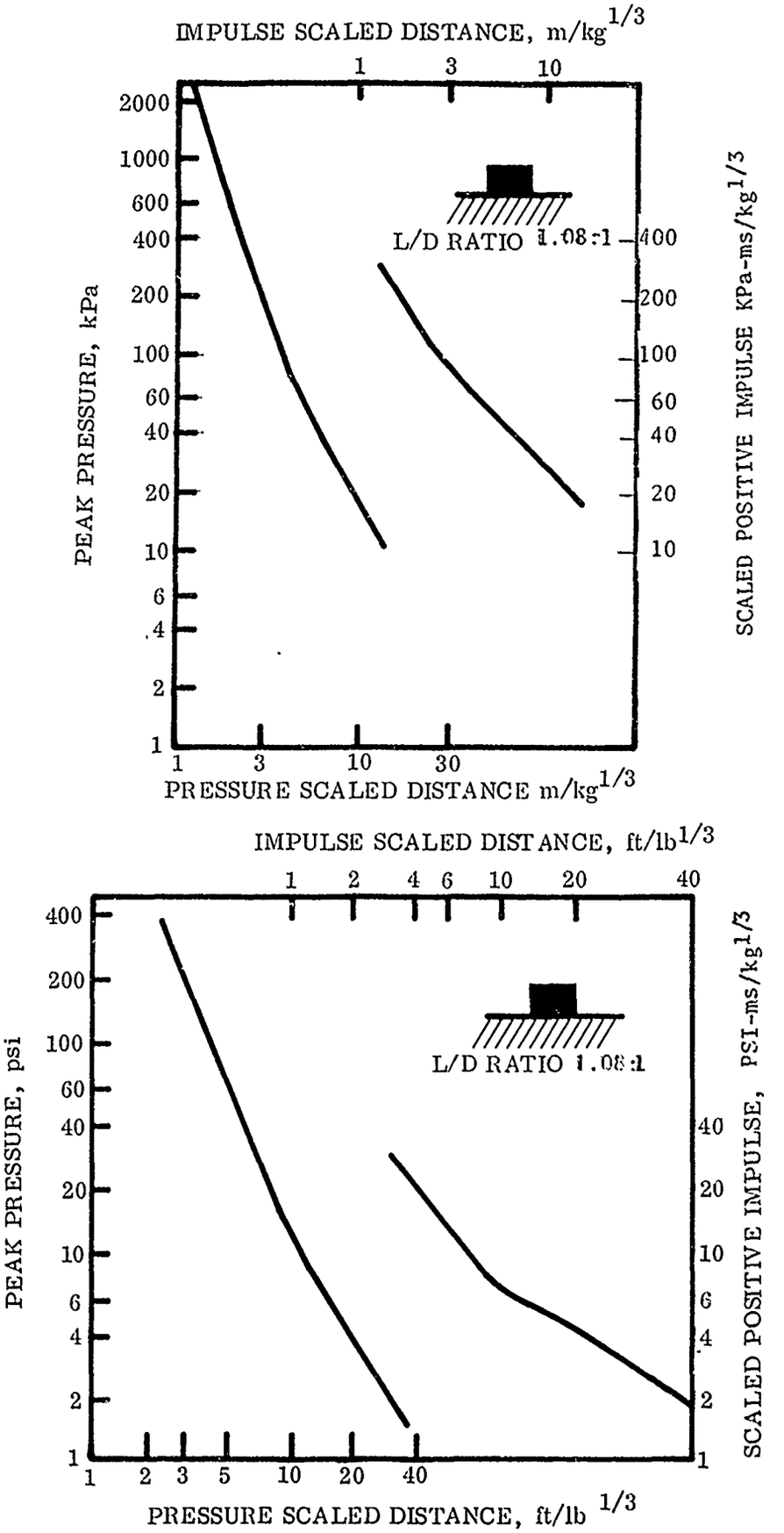

Figure 6. Pressure and Impulse versus Scaled Distance 45.4 kg (100 lb) Charge Weights

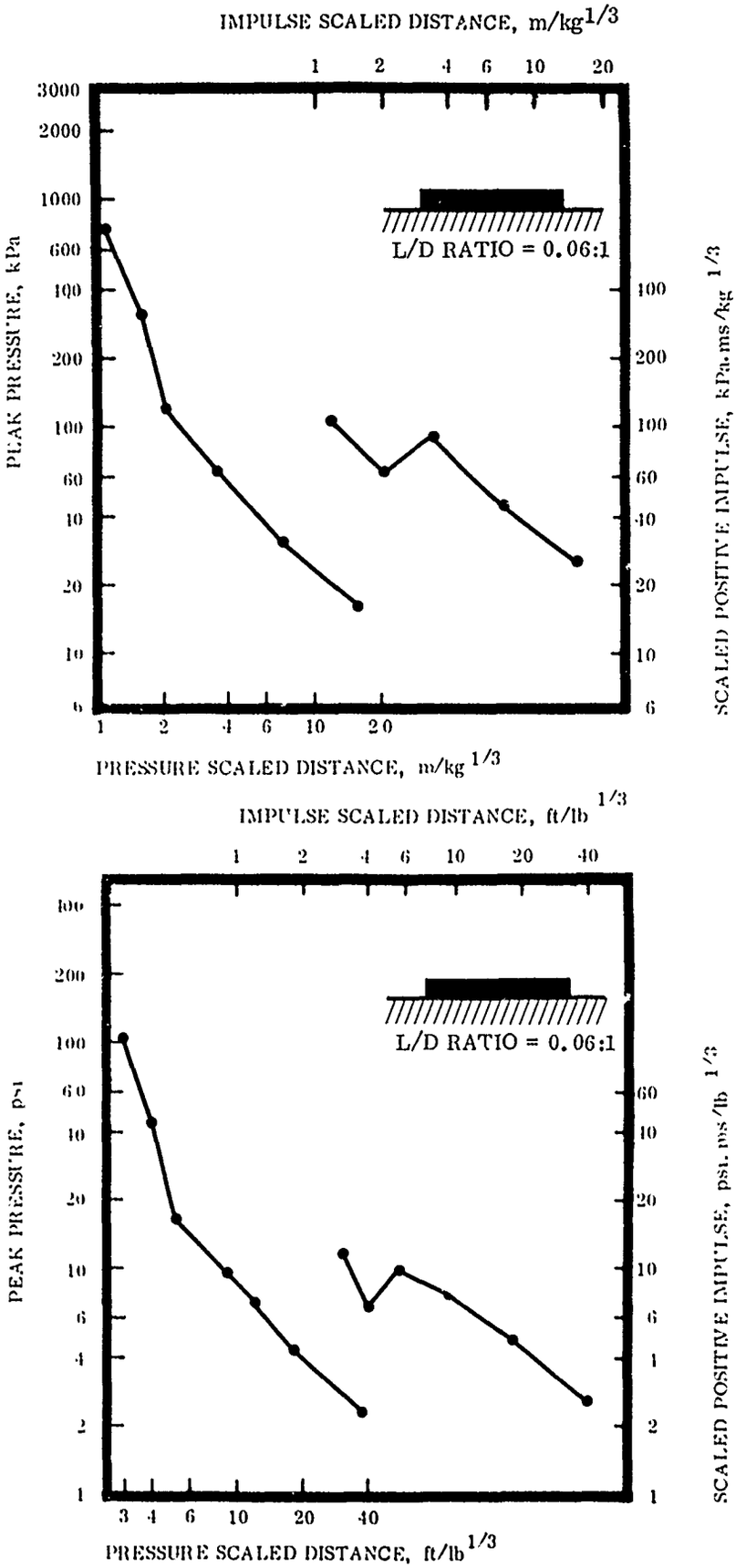

Figure 7. Pressure and Impulse versus Scaled Distance for Odd Gage Line 36.3 kg (80 lb) Charge Weight, Dryer Bed Configuration

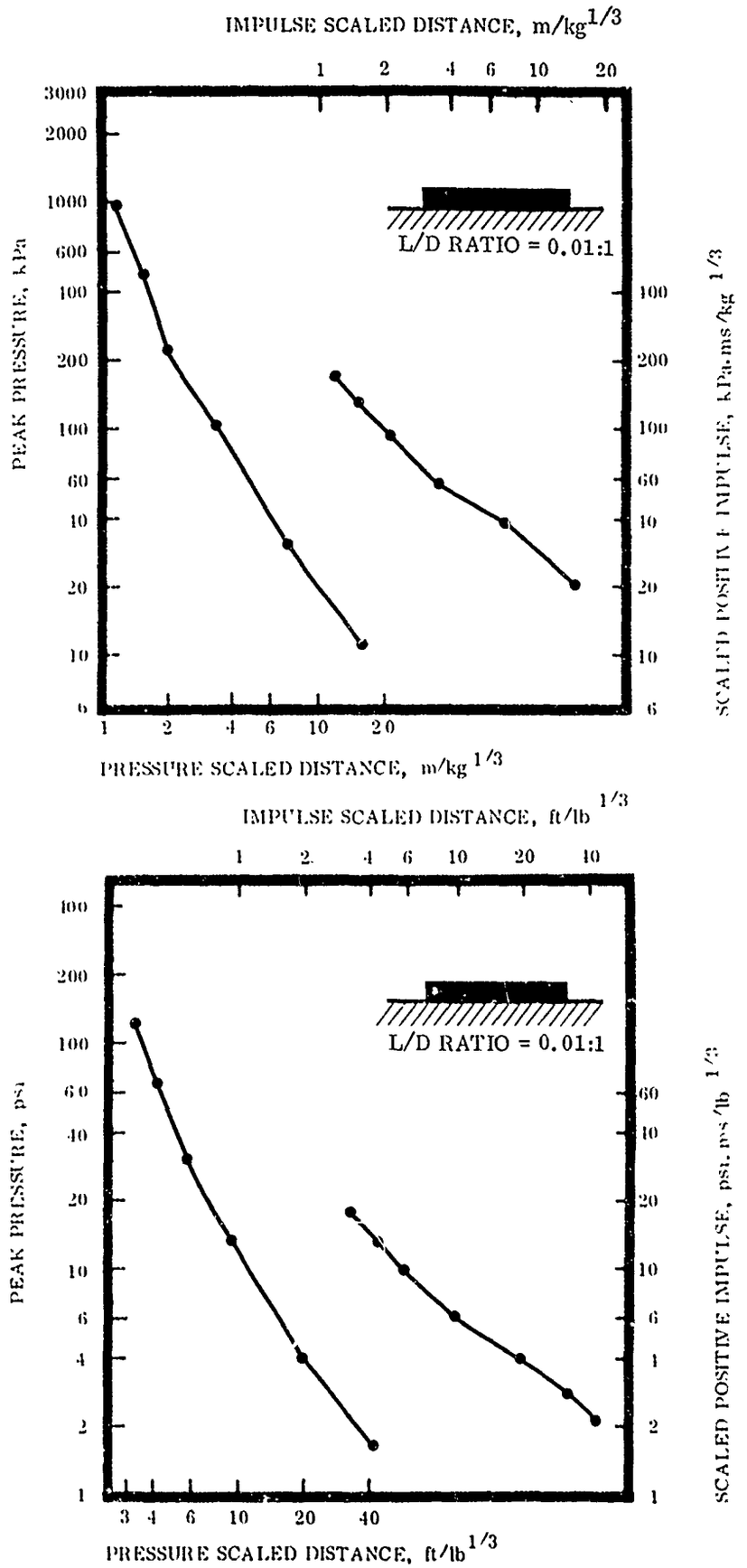

Figure 8. Pressure and Impulse versus Scaled Distance for Even Gage Line 36.3 kg (80 lb) Charge Weight, Dryer Bed Configuration

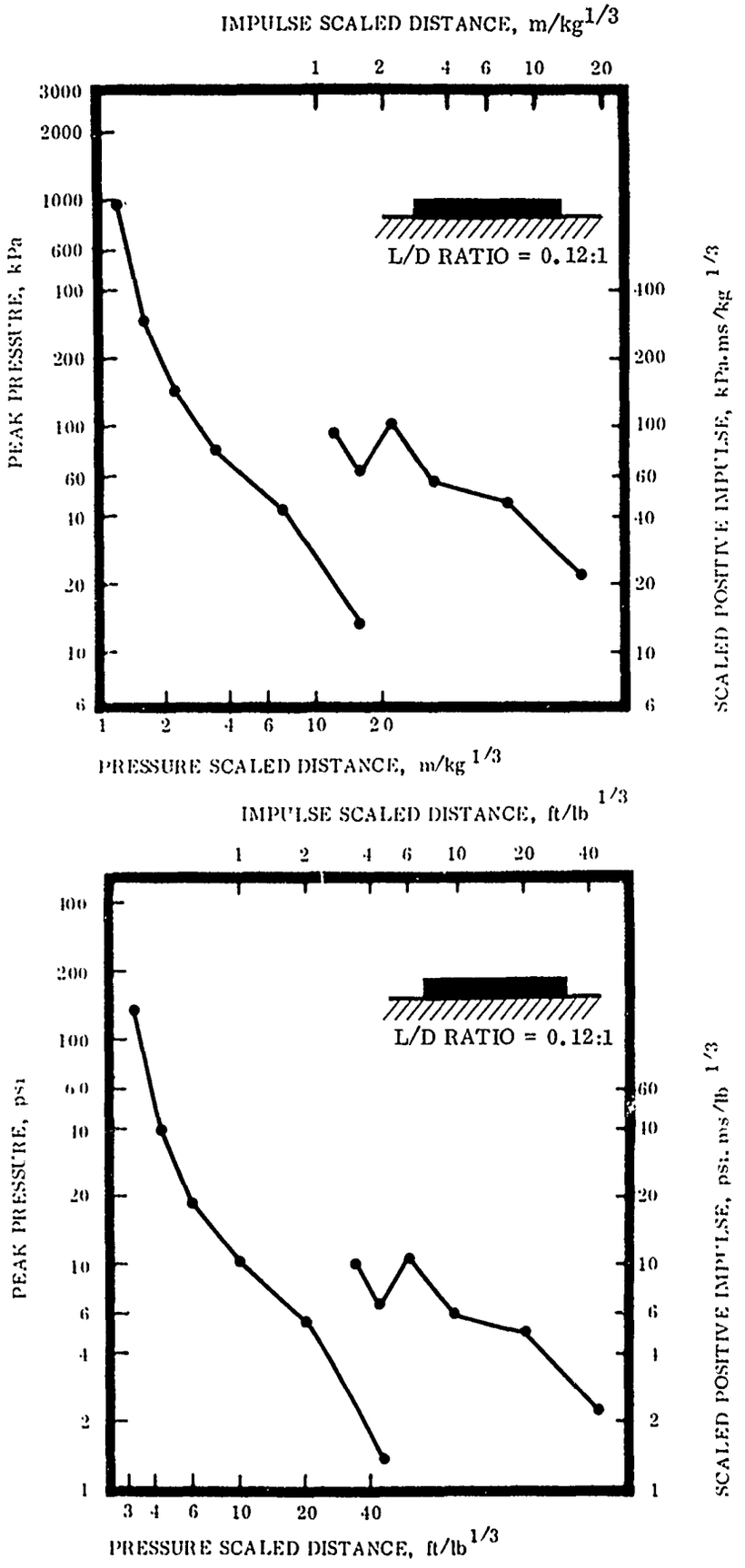

Figure 9. Pressure and Impulse versus Scaled Distance for Odd Gage Line 72.6 kg (160 lb) Charge Weight, Dryer Bed Configuration

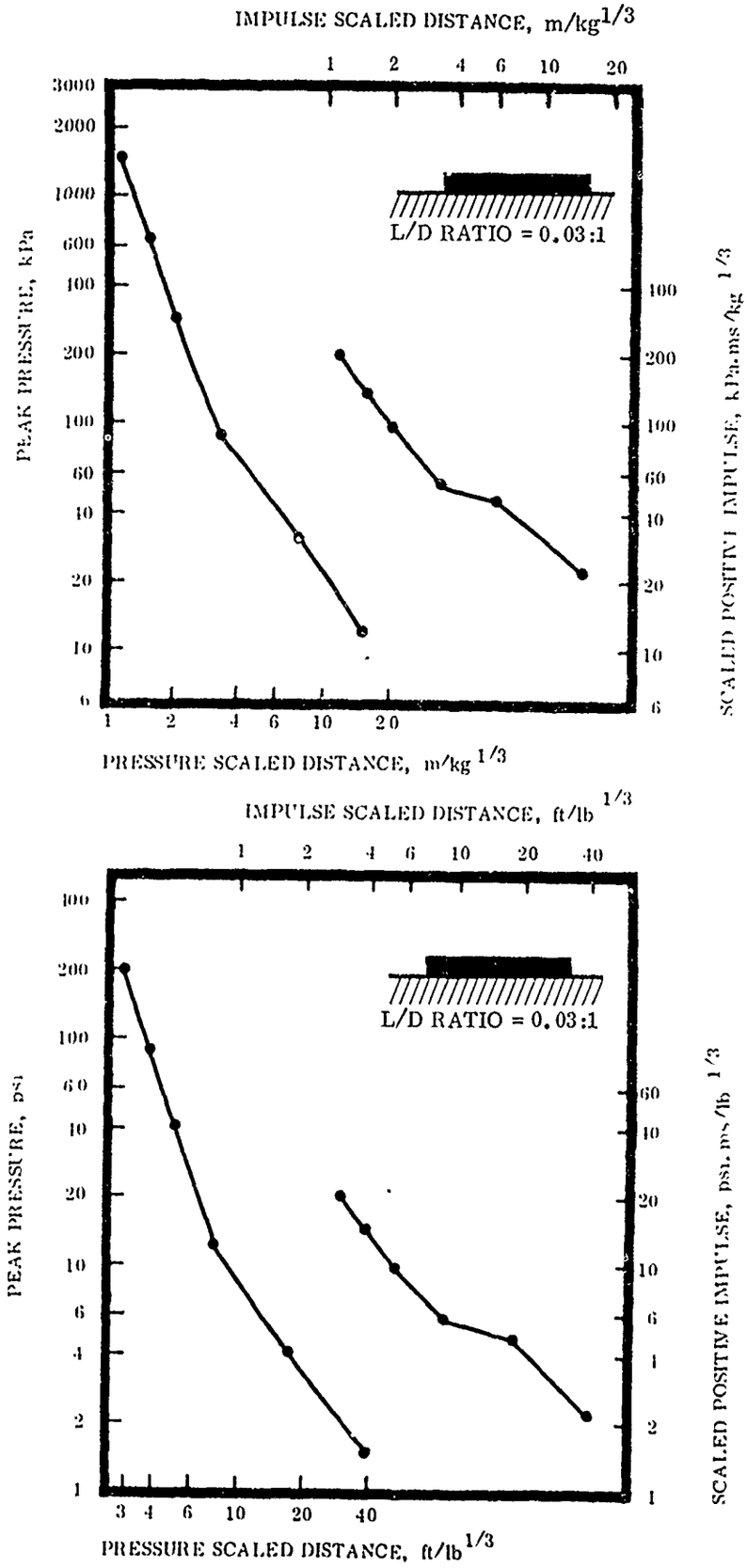

Figure 10. Pressure and Impulse versus Scaled Distance for Even Gage Line 72.6 kg (160 lb) Charge Weight, Dryer Bed Configuration

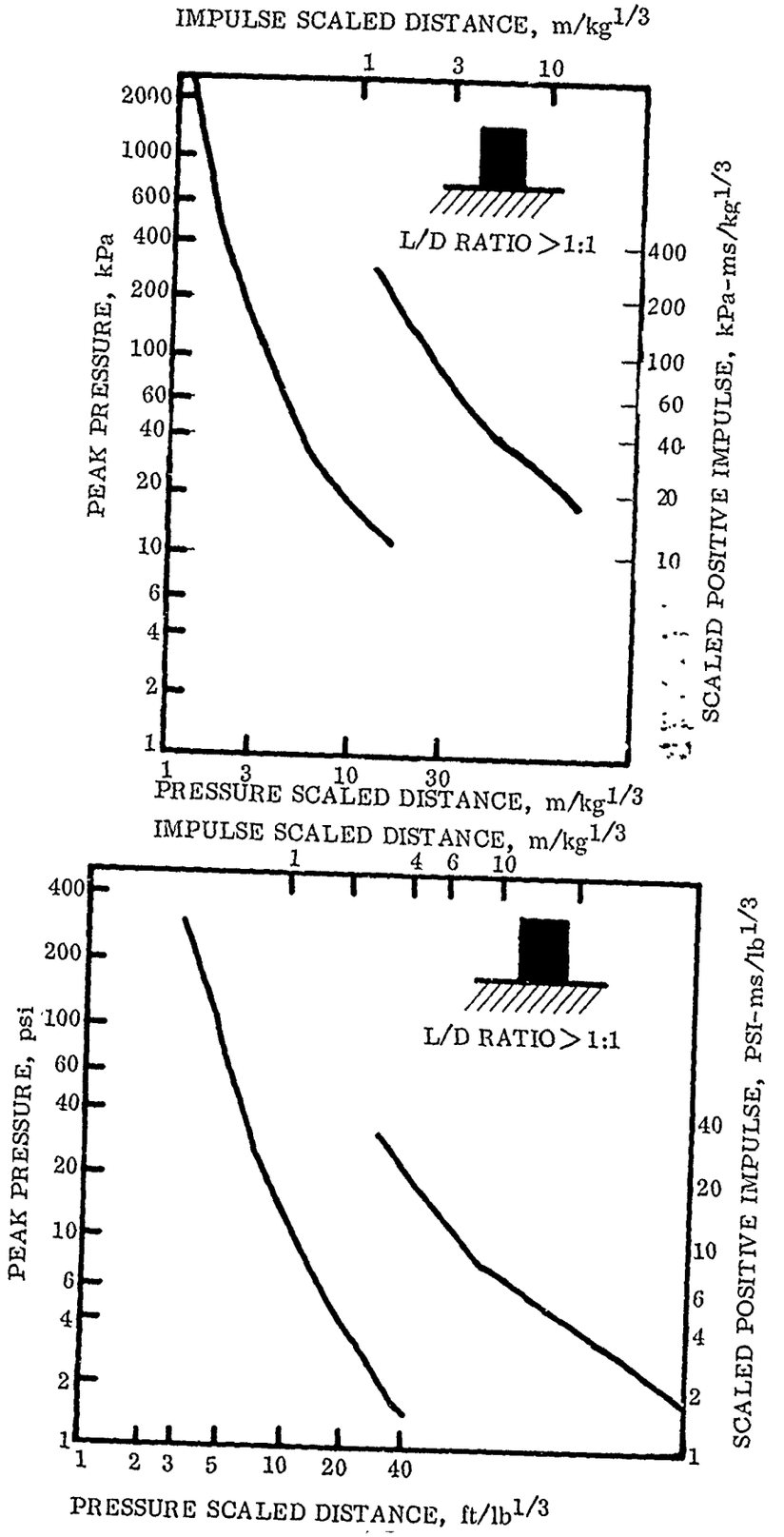

Figure 11. Pressure and Impulse versus Scaled Distance 22.7 and 45.4 kg (50 and 100 lb) Charge Weights Combined

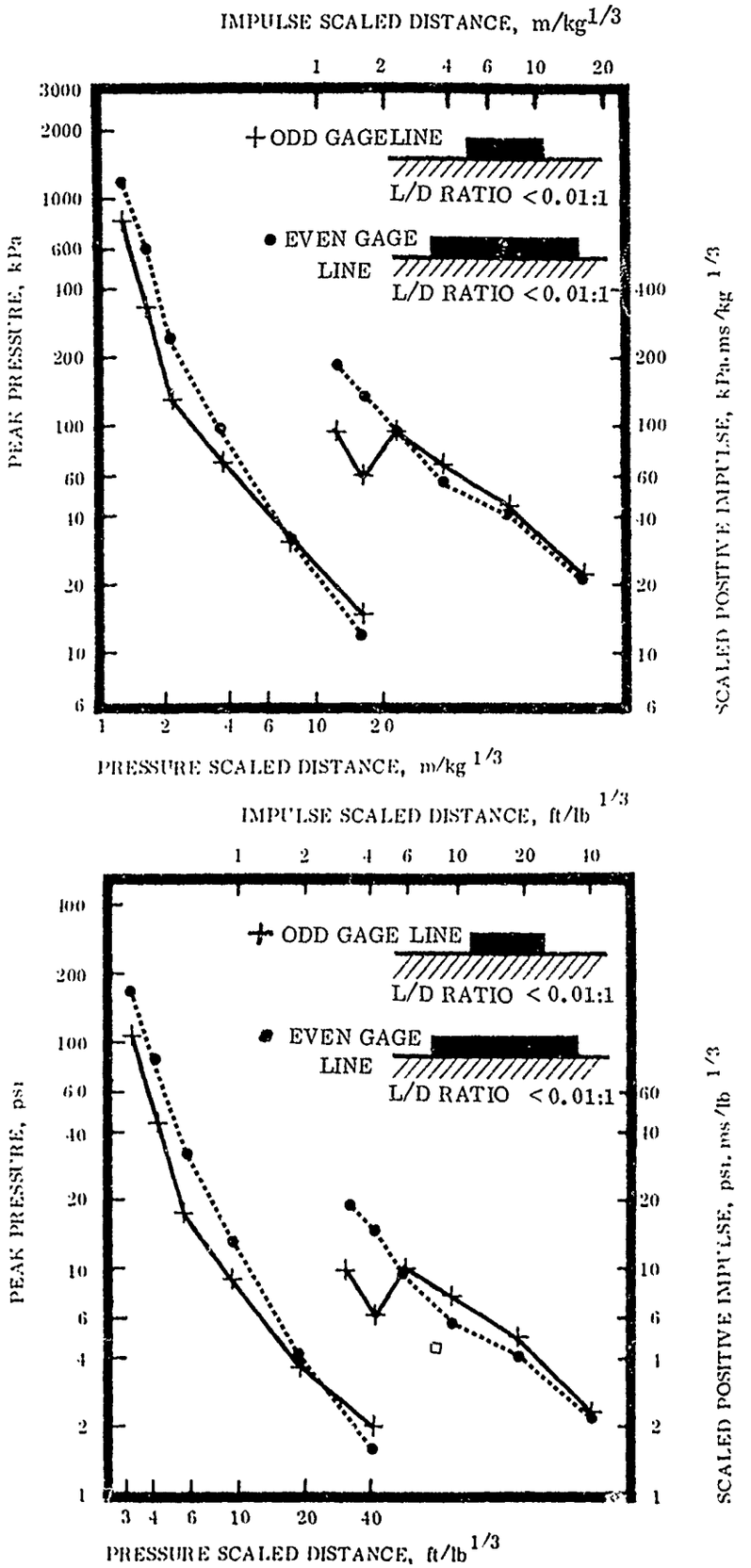

Figure 12. Pressure and Impulse versus Scaled Distance 36.3 and 72.5 kg (80 and 160 lb) Charge Weights Combined for Odd and Even Gage Values

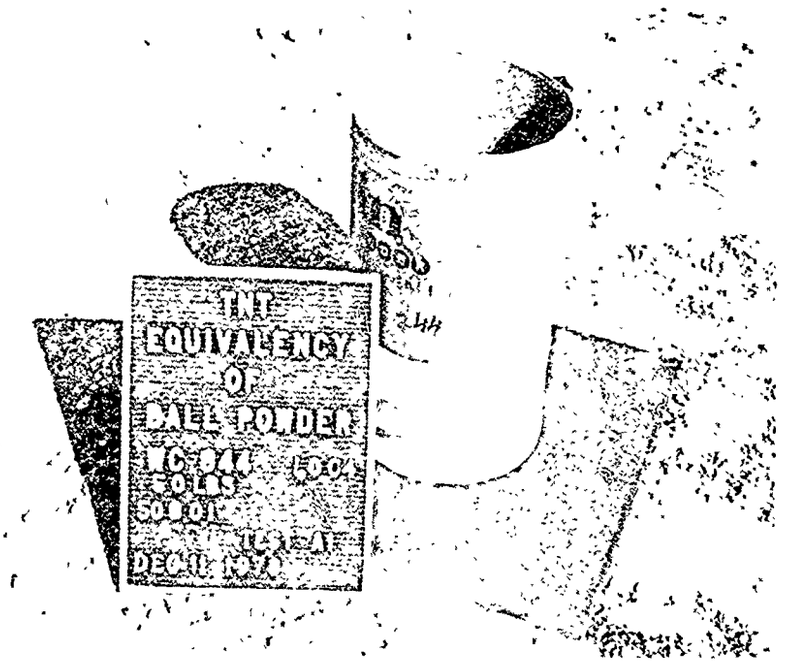

Figure 13. Pretest configuration for 22.7 kg charge

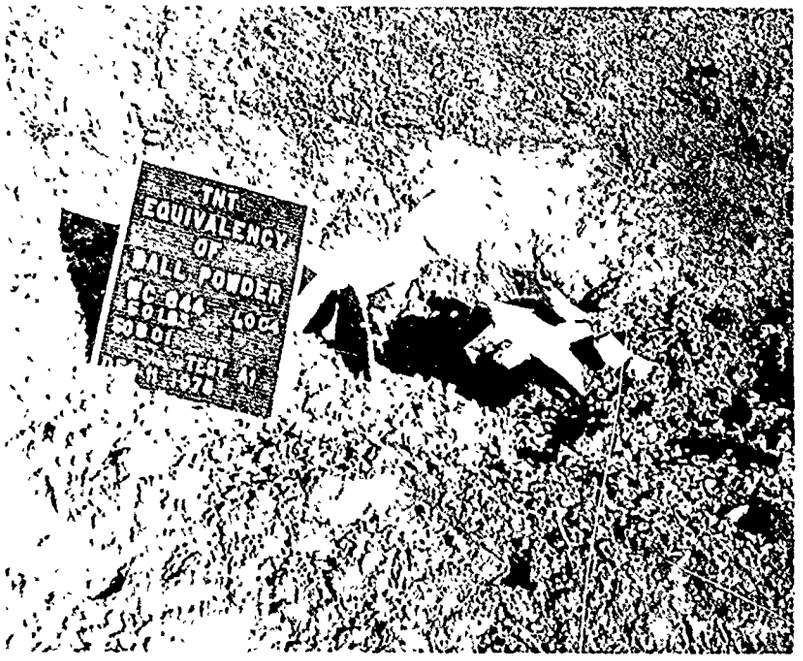

Figure 14. Posttest configuration for 22.7 kg charge

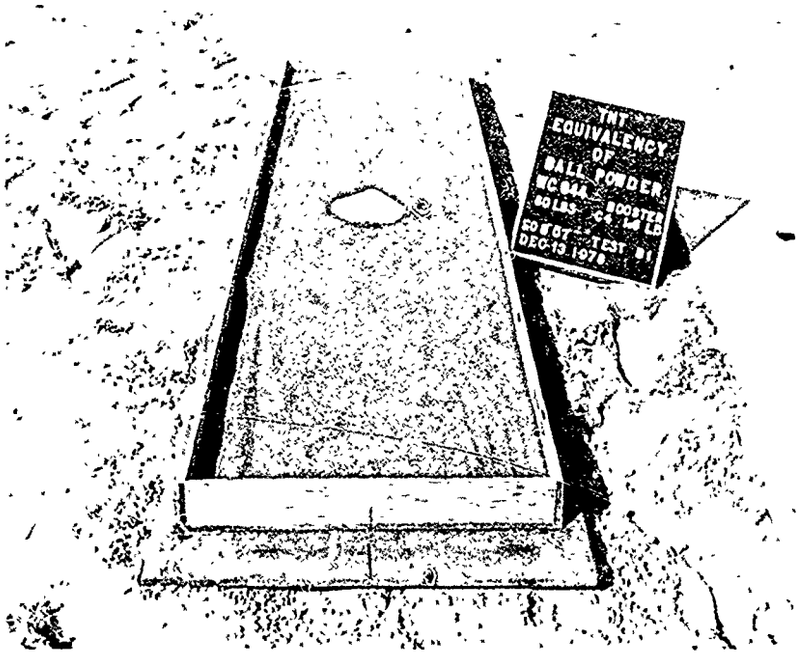

Figure 15. Pretest configuration for 45.4 kg charge

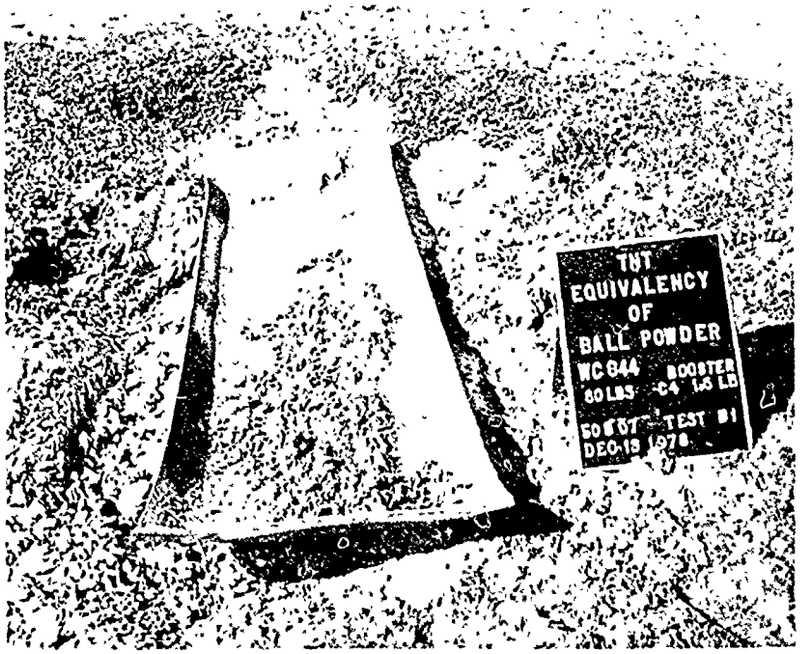

Figure 16. Posttest configuration for 45.4 kg charge

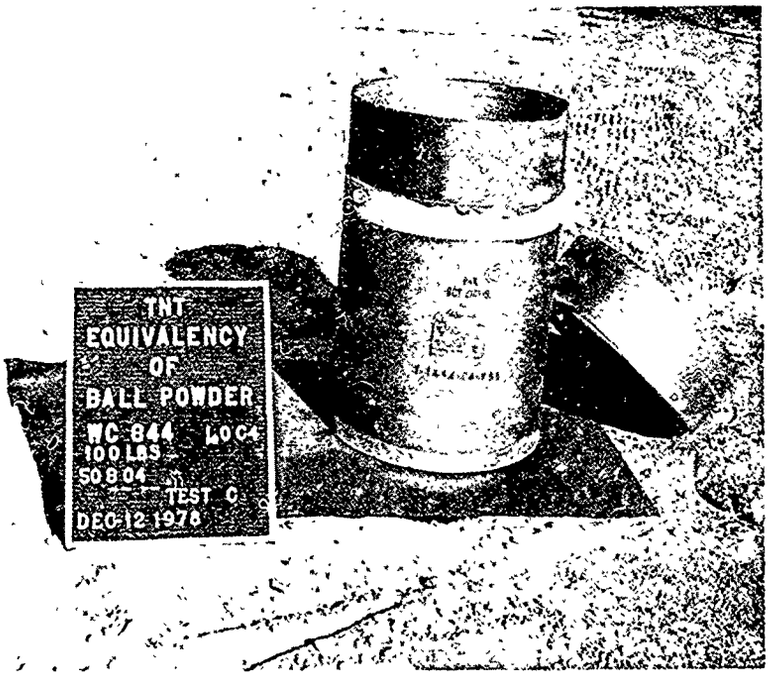

Figure 17. Pretest configuration for 36.3 kg charge

Figure 18. Posttest configuration for 36.3 kg charge

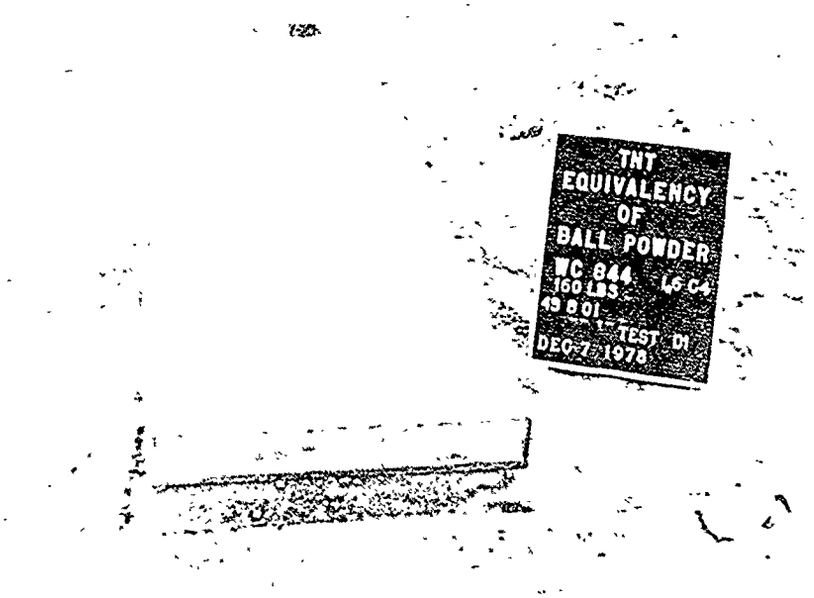

Figure 19. Pretest configuration for 72.6 kg charge

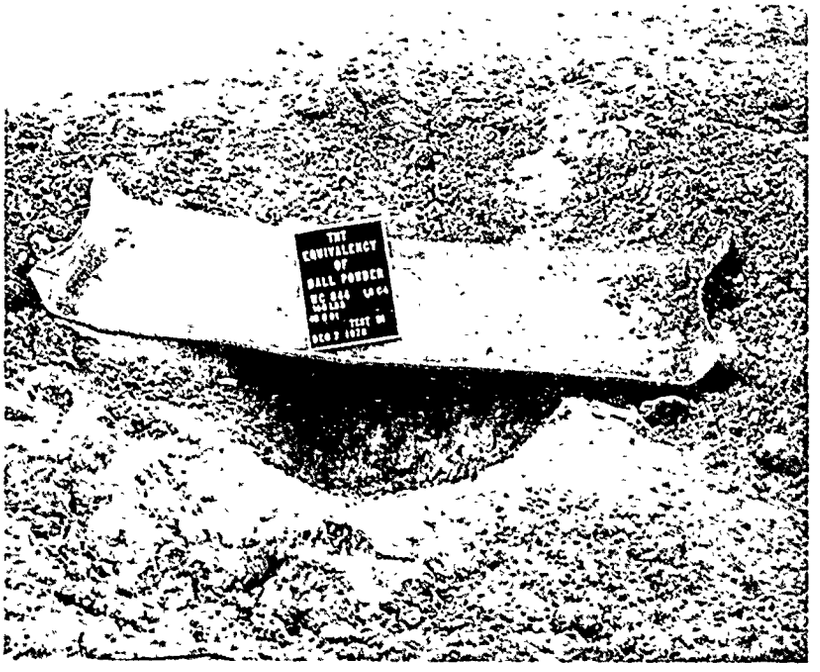

Figure 20. Posttest configuration for 72.6 kg charge

APPENDIX

DATA SHEETS

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TEST TITLE TNT Equivalency

TEST SAMPLE WC844 Ball Powder

SAMPLE WEIGHT 22.7 kg (50 lb)

IGN. SOURCE J2 Blasting Cap

BOOSTER WT. 0.45 kg (1.0 lb)

TEST NO. 50-8-01

CONTRACT NO. NAS13-50

DATE 12/11/78

TIME 1209

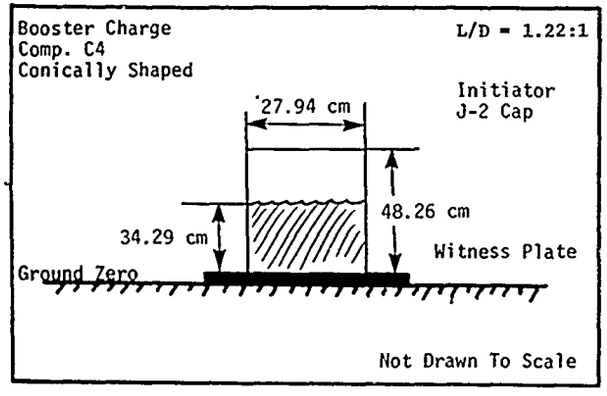
TEMP. 50°F

HUMIDITY 26%

BAR. PRESS. 30.42

WIND DIR. 330°

WIND VEL. 7 mph



FIELD EVALUATION: Detonation Occurred

Motion Picture Coverage

Crater Dimensions: 2.13 m dia by 0.58 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.37	2451 (355.49)	288 (32.13)	3.45
2	(11.05)	2222 (322.25)	250 (27.84)	3.6
3	4.49	1124 (163.01)	173 (19.3)	-
4	(14.74)	1225 (177.61)	185 (20.61)	4.7
5	6.06	390 (56.53)	118 (13.13)	6.7
6	(19.89)	449 (65.07)	125 (13.91)	6.8
7	10.11	113.2 (16.42)	65.3 (7.28)	15.2
8	(33.2)	116 (16.83)	83.5 (9.3)	14.8
9	20.21	31.7 (4.6)	35.6 (3.99)	41.6
10	(66.3)	26.2 (3.8)	41.3 (4.6)	41.5
11	44.92	9.9 (1.43)	15.8 (1.76)	112.4
12	(147.4)	9 (1.31)	15.4 (1.72)	112.1

Figure A-1. Data sheet for test 1, 22.7 kg charge

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TEST TITLE TNT Equivalency DATE 12/11/78

TEST SAMPLE WC844 Ball Powder TIME 1209

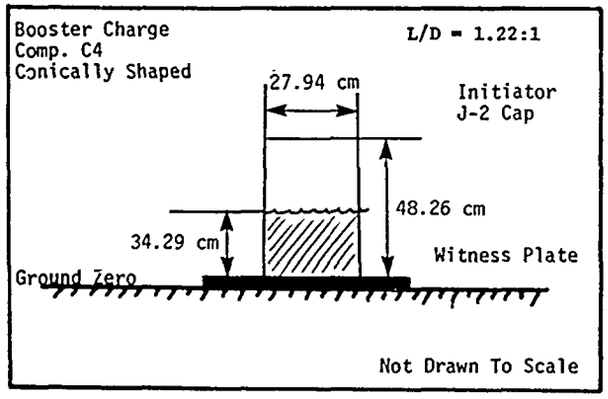
SAMPLE WEIGHT 22.7 kg (50 lb) TEMP. 52°F

IGN. SOURCE J2 Blasting Cap HUMIDITY 23%

BOOSTER WT. 0.45 kg (1.0 lb) BAR. PRESS. 30.38

TEST NO. 50-8-02 WIND DIR. 330°

CONTRACT NO. NAS13-50 WIND VEL. 5 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 2.08 m dia. by 0.51 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.37	2749 (398.69)	384 (42.81)	2.2
2	(11.05)	2107 (305.64)	156 (17.4)	2.3
3	4.49	1122 (162.67)	177 (19.75)	-
4	(14.74)	1124 (163)	188 (20.91)	3.4
5	6.06	456 (66.06)	136 (15.1)	5.2
6	(19.89)	346 (50.24)	114 (12.71)	5.5
7	10.11	- -	- -	- -
8	(33.2)	108 (15.65)	84 (9.36)	13.85
9	20.21	31.6 (4.59)	39.5 (4.4)	40
10	(66.3)	32.4 (4.7)	- -	40.1
11	44.92	11 (1.6)	15.9 (1.77)	110.9
12	(147.4)	11.1 (1.61)	16.5 (1.84)	110.15

Figure A-2. Data sheet for test 2, 22.7 kg charge

TEST TITLE TNT Equivalency DATE 12/11/78

TEST SAMPLE WC844 Ball Powder TIME 15.20

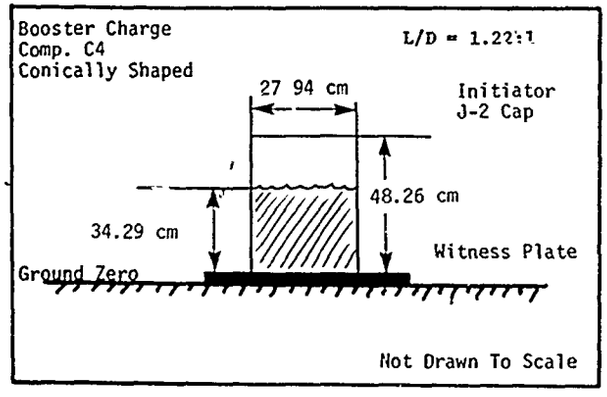
SAMPLE WEIGHT 22.7 kg (50 lb) TEMP. 52°F

IGN. SOURCE J2 Blasting Cap HUMIDITY 23%

BOOSTER WT. 0.45 kg (1.0 lb) BAR. PRESS. 30.37

TEST NO. 50-8-03 WIND DIR. 360°

CONTRACT NO. NAS13-50 WIND VEL. 6 mph



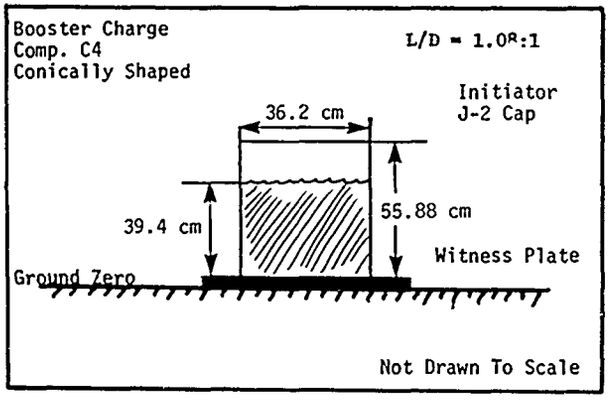
FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 2.13 m dia. by 0.55 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.37	2635 (382.17)	382 (42.56)	3.1
2	(11.05)	2579 (374.06)	319 (35.57)	3.2
3	4.49	1124 (162.95)	166 (18.49)	-
4	(14.74)	1247 (180.91)	176 (19.65)	4.2
5	6.06	377 (54.67)	145 (16.11)	6.1
6	(19.89)	406 (58.85)	116 (12.88)	6.2
7	10.11	- -	- -	- -
8	(33.2)	129 (18.64)	83.3 (9.34)	14.5
9	20.21	31.1 (4.51)	40.5 (4.51)	40.7
10	(66.3)	32.4 (4.7)	40.2 (4.48)	40.7
11	44.92	11 (1.6)	19 (. 12)	111.5
12	(147.4)	10.5 (1.53)	17.9 (1.99)	110.9

Figure A-3. Data sheet for test 3, 22.7 kg charge

TEST TITLE	TNT Equivalency	DATE	12/12/78
TEST SAMPLE	WC844 Ball Powder	TIME	1400
SAMPLE WEIGHT	45.4 kg (100 lb)	TEMP.	68°F
IGN. SOURCE	J2 Blasting Cap	HUMIDITY	25%
BOOSTER WT.	0.45 kg (1.0 lb)	BAR. PRESS.	30.32
TEST NO.	50-8-04	WIND DIR.	300°
CONTRACT NO.	NAS13-50	WIND VEL.	2 mph



FIELD EVALUATION: Detonation Occurred

Motion Picture Coverage

Crater Dimensions: 3.05 m dia. by 0.74 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.24	1816 (263.35)	71.2 (7.93)	2.4
2	(13.92)	2440 (353.89)	323 (36.01)	2.5
3	5.73	701 (101.7)	46.6 (5.19)	3.2
4	(18.8)	1198 (173.71)	149 (16.62)	3.55
5	7.61	411 (59.55)	106 (11.8)	5.55
6	(24.97)	310 (45.01)	119 (13.3)	5.5
7	12.73	116 (16.85)	68.1 (7.59)	15.6
8	(41.77)	74.3 (10.77)	48.3 (5.44)	14.5
9	25.47	30.1 (4.37)	41.4 (4.61)	48.85
10	(83.55)	25.2 (3.65)	37.3 (4.16)	49
11	56.59	9.2 (1.33)	16.1 (1.79)	137
12	(185.66)	10.5 (1.52)	18.4 (2.05)	136.4

Figure A-4. Data sheet for test 4, 45.4 kg charge

TEST TITLE TNT Equivalency

TEST SAMPLE WC844 Ball Powder

SAMPLE WEIGHT 45.4 kg (100 lb)

IGN. SOURCE J2 Blasting Cap

BOOSTER WT. 0.45 kg (1.0 lb)

TEST NO. 50-8-05

CONTRACT NO. NAS13-50

DATE 12/12/78

TIME 1447

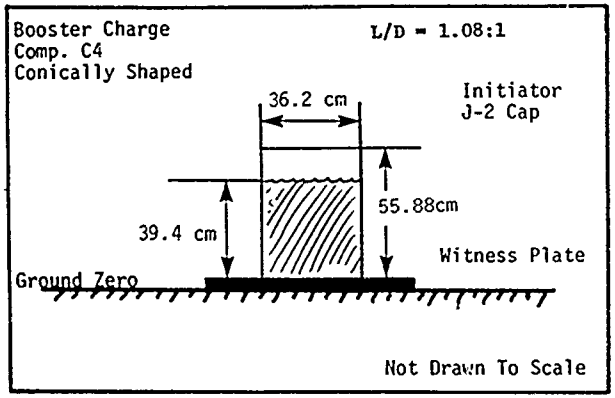
TEMP. 69°F

HUMIDITY 24%

BAR. PRESS. 30.30

WIND DIR. 320°

WIND VEL. 2 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 2.44 m dia by 0.51 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.24	2433 (352.9)	233.1 (25.98)	3.65
2	(13.92)	2950 (427.89)	310 (34.59)	3.75
3	5.73	623 (90.4)	92.3 (10.34)	5
4	(18.8)	1178 (170.82)	176 (19.62)	5.1
5	7.61	490 (71.11)	130 (14.45)	7.3
6	(24.97)	561 (81.4)	115 (12.79)	7.4
7	12.73	119 (17.31)	72.7 (8.1)	17
8	(41.77)	92 (13.28)	57 (6.35)	17
9	25.47	27.5 (3.99)	41.6 (4.64)	50.5
10	(83.55)	26.8 (3.88)	36.4 (4.06)	50.55
11	56.59	10.9 (1.58)	17.2 (1.92)	137.7
12	(185.66)	9.7 (1.4)	16.9 (1.88)	137.8

Figure A-5. Data sheet for test 5, 45.4 kg charge

TEST TITLE TNT Equivalency

TEST SAMPLE WC844 Ball Powder

SAMPLE WEIGHT 45.4 kg (100 lb)

IGN. SOURCE J2 Blasting Cap

BOOSTER WT. 0.45 kg (1.0 lb)

TEST NO. 50-8-06

CONTRACT NO. NAS13-50

DATE 12/12/78

TIME 1545

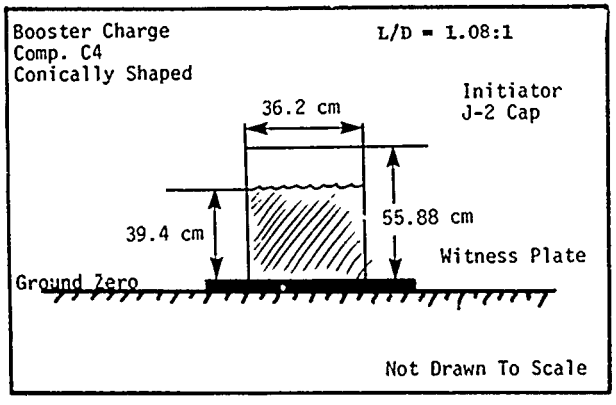
TEMP. 65°F

HUMIDITY 32%

BAR. PRESS. 30.30

WIND DIR. 330°

WIND VEL. 4 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 3.05 m dia. by 0.51 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.24	2597 (376.6)	252 (28.07)	3.4
2	(13.92)	2440 (353.89)	306 (34.05)	3.5
3	5.73	899.5 (130.46)	194 (21.65)	4.2
4	(18.8)	1337 (193.98)	164 (18.25)	4.7
5	7.61	362 (52.44)	109 (12.15)	6.9
6	(24.97)	390 (56.5)	125 (13.91)	7.1
7	12.73	95.4 (13.84)	68.8 (7.67)	17.5
8	(41.77)	107 (15.57)	53.8 (5.99)	17.6
9	25.47	32.2 (4.67)	38.6 (4.3)	50.6
10	(83.55)	33.7 (4.89)	35.9 (4)	50.5
11	56.59	10.4 (1.51)	17.1 (1.91)	138.4
12	(185.66)	10.2 (1.48)	17.1 (1.91)	138

Figure A-6. Data sheet for test 6, 45.4 kg charge

TEST TITLE TNT Equivalency — DATE 12/13/78

TEST SAMPLE WC844 Ball Powder — TIME 1216

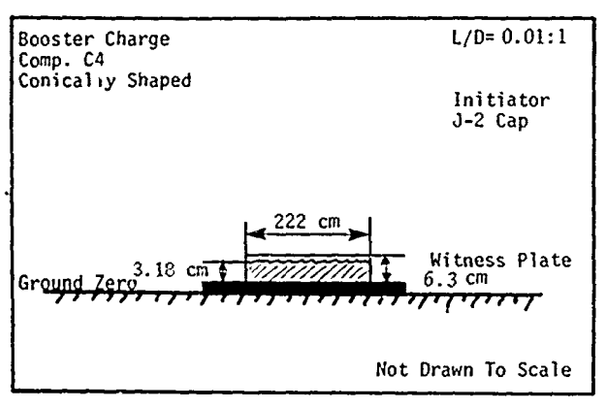
SAMPLE WEIGHT 36.3 kg (80 lb) — TEMP. 65°F

IGN. SOURCE J2 Blasting Cap — HUMIDITY 33%

BOOSTER WT. 0.73 kg (1.6 lb) — BAR. PRESS. 30.37

TEST NO. 50-8-07 — WIND DIR. 315°

CONTRACT NO. NAS13-50 — WIND VEL. 7 mph



FIELD EVALUATION: Detonation Occurred

Motion Picture Coverage

Crater Dimensions: 3.2 m long by 1.82 m wide by 0.3 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.94	649 (94.19)	104 (11.55)	2.5
2	(12.93)	1043 (151.25)	181 (20.12)	3.1
3	5.32	327 (47.41)	57.9 (6.45)	4.8
4	(17.45)	532 (77.17)	144 (16)	5
5	7.07	96 (13.85)	79.5 (8.86)	8.6
6	(23.18)	210 (30.41)	80.8 (9)	8
7	11.82	129 (18.77)	62.5 (6.97)	20.7
8	(38.78)	96 (13.93)	58.1 (6.47)	18.2
9	23.64	26.3 (3.82)	41.5 (4.63)	52.4
10	(77.56)	29.8 (4.32)	37.2 (4.15)	48.6
11	52.53	15.2 (2.21)	22.8 (2.54)	133.4
12	(172.35)	11.2 (1.62)	21.4 (2.38)	129.7

Figure A-7. Data sheet for test 7, 36.3 kg charge

TEST TITLE TNT Equivalency

TEST SAMPLE WC844 Ball Powder

SAMPLE WEIGHT 36.3 kg (80 lb)

IGN. SOURCE J2 Blasting Cap

BOOSTER WT. 0.73 kg (1.6 lb)

TEST NO. 50-8-08

CONTRACT NO. NAS13-50

DATE 12/13/78

TIME 1355

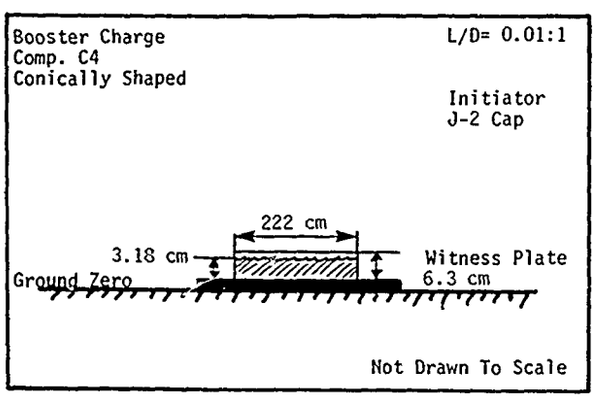
TEMP. 68°F

HUMIDITY 25%

BAR. PRESS. 30.32

WIND DIR. 300°

WIND VEL. 2 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 3.2 m long by 1.83 m wide by 0.3 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.94	812 (117.74)	128 (14.29)	3.4
2	(12.93)	983 (142.52)	168 (18.73)	4.5
3	5.32	354 (51.36)	69.7 (7.77)	5.2
4	(17.45)	426 (61.73)	106.3 (11.85)	6.2
5	7.07	127 (18.46)	85.5 (9.53)	8.9
6	(23.18)	210 (30.41)	83.6 (9.32)	9.2
7	11.82	58.9 (8.54)	67.8 (7.55)	21.4
8	(38.78)	99.4 (14.41)	56.6 (6.31)	19.7
9	23.64	30.6 (4.44)	45.2 (5.04)	53.3
10	(77.56)	29.8 (4.32)	39.5 (4.4)	50.1
11	52.53	16.4 (2.38)	25.3 (2.82)	133.4
12	(172.35)	11.2 (1.62)	19.7 (2.19)	130.6

Figure A-8. Data sheet for test 8, 36.3 kg charge

TEST TITLE TNT Equivalency — DATE 12/13/78

TEST SAMPLE WC844 Ball Powder — TIME 1505

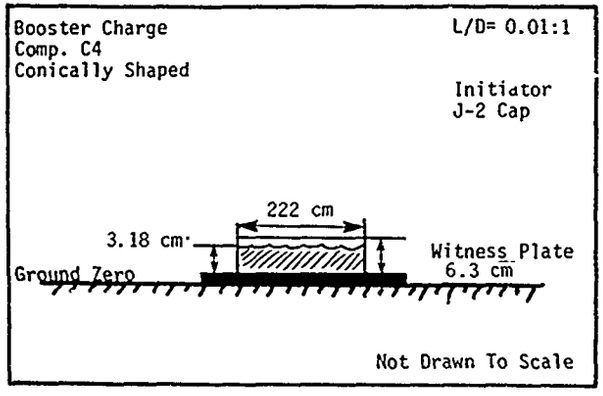
SAMPLE WEIGHT 36.3 kg (80 lb) — TEMP. 69°F

IGN. SOURCE J2 Blasting Cap — HUMIDITY 24%

BOOSTER WT. 0.73 kg (1.6 lb) — BAR. PRESS. 30.30

TEST NO. 50-8-09 — WIND DIR. 320°

CONTRACT NO. NAS13-50 — WIND VEL. 2 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 3.05 m long by 2.44 m wide by 0.3 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	3.94	741 (107.43)	82.27 (9.21)	3.4
2	(12.93)	752 (109.07)	157 (17.48)	4.3
3	5.32	262 (37.93)	53.6 (5.97)	5.7
4	(17.45)	- -	- -	6.15
5	7.07	121 (17.54)	93.4 (10.41)	9.7
6	(23.18)	210 (30.41)	107 (11.87)	9.2
7	11.82	70 (10.15)	73.9 (8.23)	21.7
8	(38.78)	99.4 (14.41)	56.1 (6.25)	19.7
9	23.64	31.1 (4.51)	45 (5.02)	53.3
10	(77.56)	30.3 (4.39)	39.2 (4.37)	50
11	52.53	15.2 (2.21)	24.4 (2.72)	133.5
12	(172.35)	11.2 (1.62)	20.8 (2.32)	130.7

Figure A-9. Data sheet for test 9, 36.3 kg charge

TEST TITLE TNT Equivalency DATE 12/7/78

TEST SAMPLE WC844 Ball Powder TIME 1255

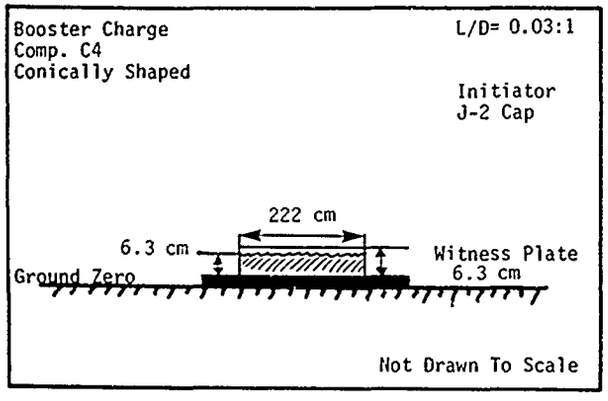
SAMPLE WEIGHT 72.6 kg (160 lb) TEMP. 80°F

IGN. SOURCE J2 Blasting Cap HUMIDITY 90%

BOOSTER WT. 0.73 kg (1.6 lb) BAR. PRESS. 30.0

TEST NO. 50-8-10 WIND DIR. 165

CONTRACT NO. NAS13-50 WIND VEL. 7 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 4.04 m long by 3.76 m wide by 0.91 m deep

Motion Picture Coverage

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.97	964 (139.8)	84.9 (9.46)	4.2
2	(16.29)	1139 (165.14)	181 (20.11)	5
3	6.7	311 (45.16)	51.5 (5.74)	-
4	(21.99)	615 (89.14)	44.7 (14.98)	7
5	8.9	161 (23.38)	66.2 (7.38)	11.3
6	(29.21)	270 (39.16)	75.1 (8.37)	10.5
7	14.89	70.1 (10.17)	63.2 (7.04)	26.3
8	48.86	81.2 (11.77)	46.8 (5.22)	23.4
9	29.79	49.4 (7.16)	47.3 (5.27)	65
10	(97.72)	29.2 (4.23)	39.8 (4.44)	61.5
11	66.19	18.5 (2.69)	19.9 (2.22)	162.6
12	(217.15)	- -	- -	- -

Figure A-10. Data sheet for test 10, 72.6 kg charge

TEST TITLE TNT Equivalency

TEST SAMPLE WC844 Ball Powder

SAMPLE WEIGHT 72.6 kg (160 lb)

IGN. SOURCE J2 Blasting Cap

BOOSTER WT. 1.45 kg (3.2 lb)

TEST NO. 50-8-11

CONTRACT NO. NAS13-50

DATE 12/14/78

TIME 1145

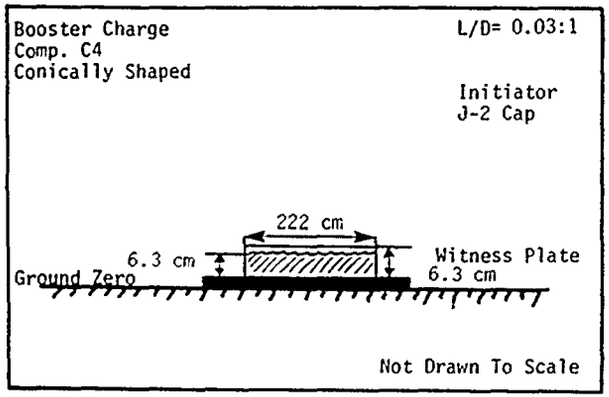
TEMP. 61°F

HUMIDITY 22%

BAR. PRESS. 30.35

WIND DIR. 100°

WIND VEL. 4 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: 3.96 m long by 2.74 m wide by 0.51 m deep

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.97	621 (90.07)	79.8 (8.89)	4.3
2	(16.29)	1678 (243.32)	181 (20.14)	4.8
3	6.7	218 (31.68)	59 (5.57)	7.25
4	(21.99)	589 (85.47)	143 (15.96)	6.5
5	8.9	129 (18.75)	125 (13.87)	12.3
6	(29.21)	287 (41.67)	99.8 (11.12)	9.8
7	14.89	84.3 (12.22)	72.6 (8.09)	28.2
8	(48.86)	84.7 (12.29)	54.1 (6.03)	23.5
9	29.79	36.5 (5.29)	45.5 (5.07)	67.2
10	(97.72)	31.4 (4.56)	57.4 (6.4)	62.4
11	66.19	12.8 (1.85)	20.3 (2.26)	169.2
12	(217.15)	11 (1.59)	21.2 (2.36)	165

Figure A-11. Data sheet for test 11, 72.6 kg charge

TEST TITLE TNT Equivalency — DATE 12/14/78

TEST SAMPLE WC844 Ball Powder — TIME 1414

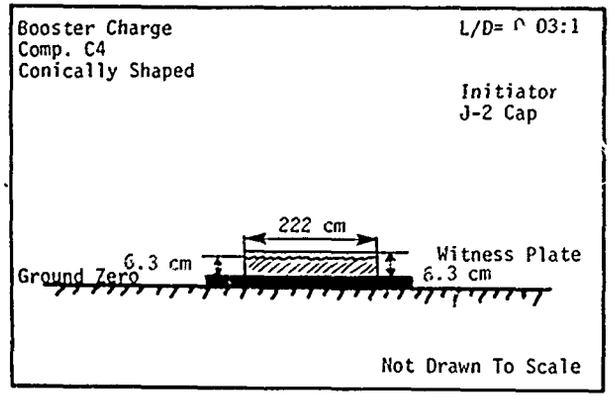
SAMPLE WEIGHT 72.6 kg (160 lb) — TEMP. 56°F

IGN. SOURCE J2 Blasting Cap — HUMIDITY 24%

BOOSTER WT. 1.45 kg (3.2 lb) — BAR. PRESS. 30.30

TEST NO. 50-8-12 — WIND DIR. 25°

CONTRACT NO. NAS13-50 — WIND VEL. 5 mph



FIELD EVALUATION: Detonation Occurred

Crater Dimensions: Not Available

Channel Number	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Positive Impulse kPa msec/kg$^{1/3}$ (psi msec/lb$^{1/3}$)	Time of Arrival (msec)
1	4.97	1221. (177.13)	113 (12.58)	4.2
2	(16.29)	1379. (199.99)	244 (24.94)	5
3	6.7	327. (47.52)	73 (8.14)	6.6
4	(21.99)	610. (88.52)	126 (14.01)	7
5	8.9	118. (17.18)	103 (11.51)	11.5
6	(29.21	287. (41.67)	103 (11.49)	10.4
7	14.89	71. (10.34)	31.5 (3.51)	27.45
8	(48.86)	88. (12.78)	61.3 (6.83)	23.8
9	29.79	35. (5.13)	45.1 (5.03)	67.4
10	(97.72)	29. (4.25)	40.1 (4.47)	63
11	66.19	12.7 (1.85)	20.6 (2.29)	169.4
12	(217.15)	11.5 (1.67)	20.8 (2.32)	165.4

Figure A-12. Data sheet for test 12, 72.6 kg charge

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